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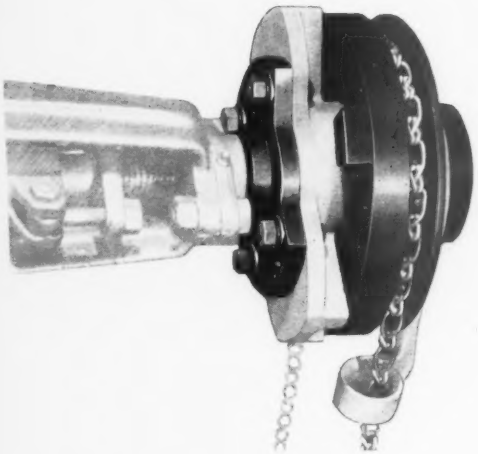

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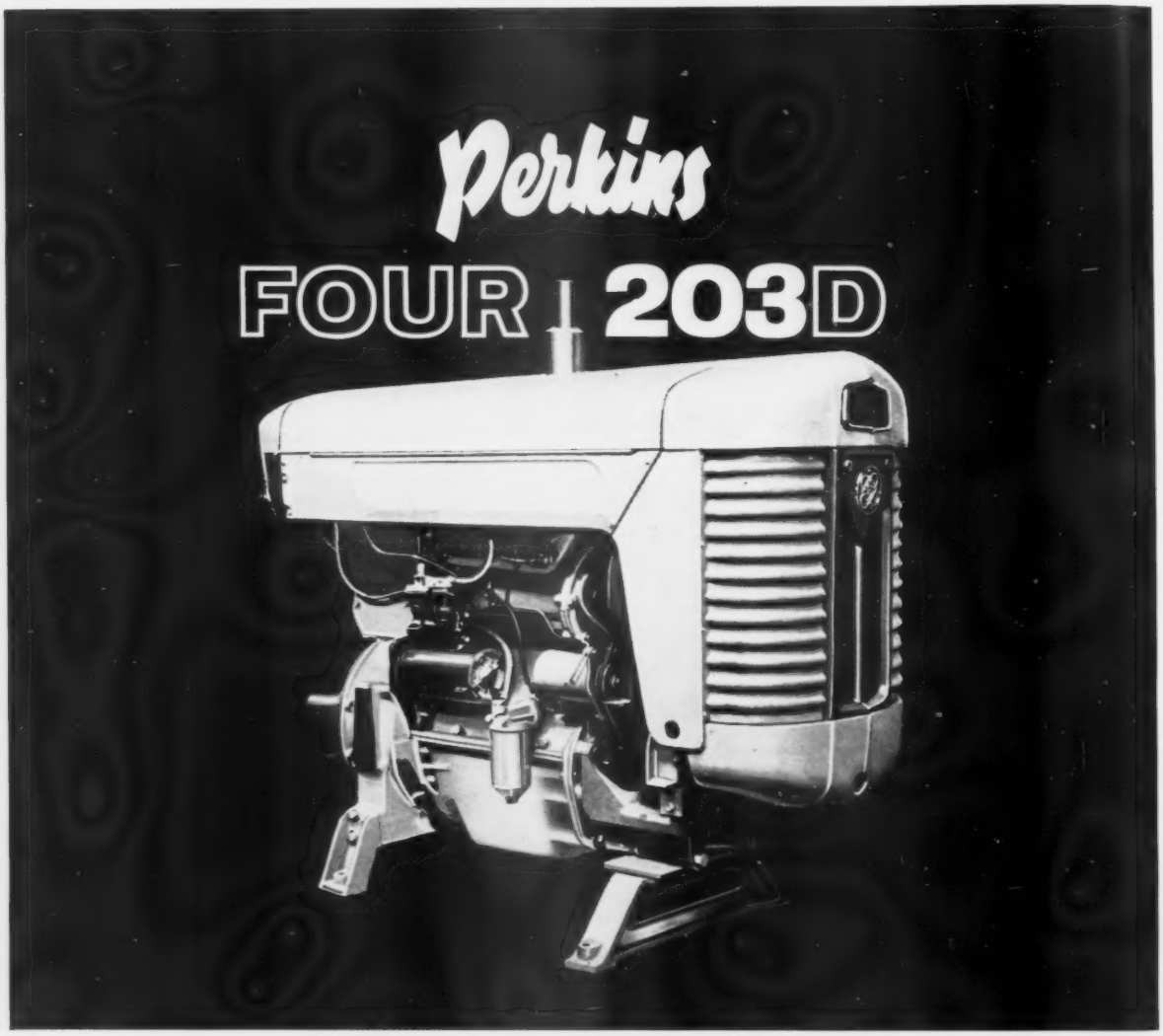


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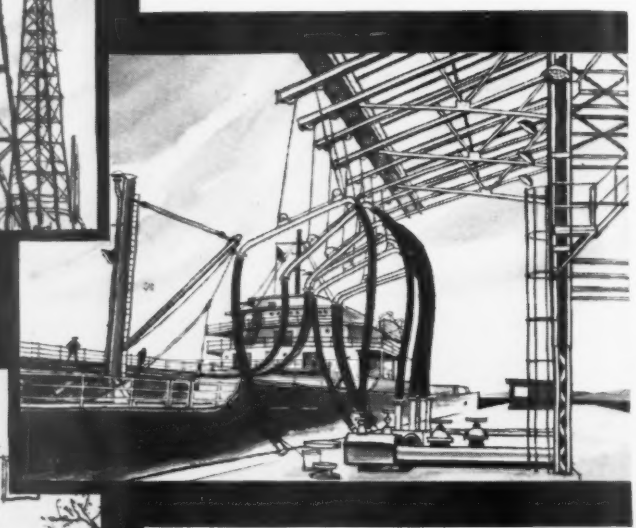

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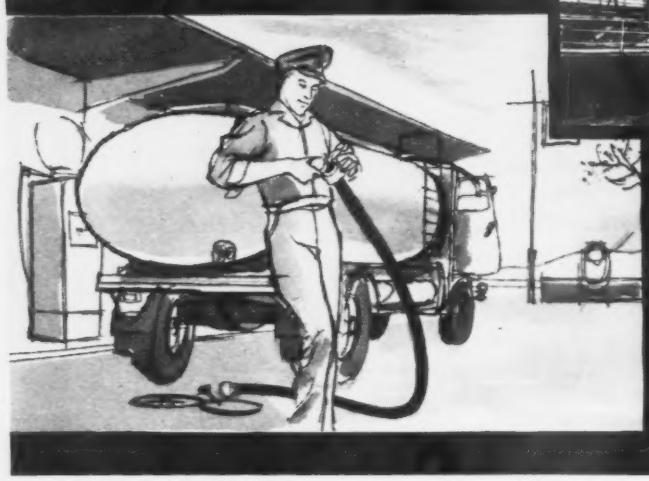

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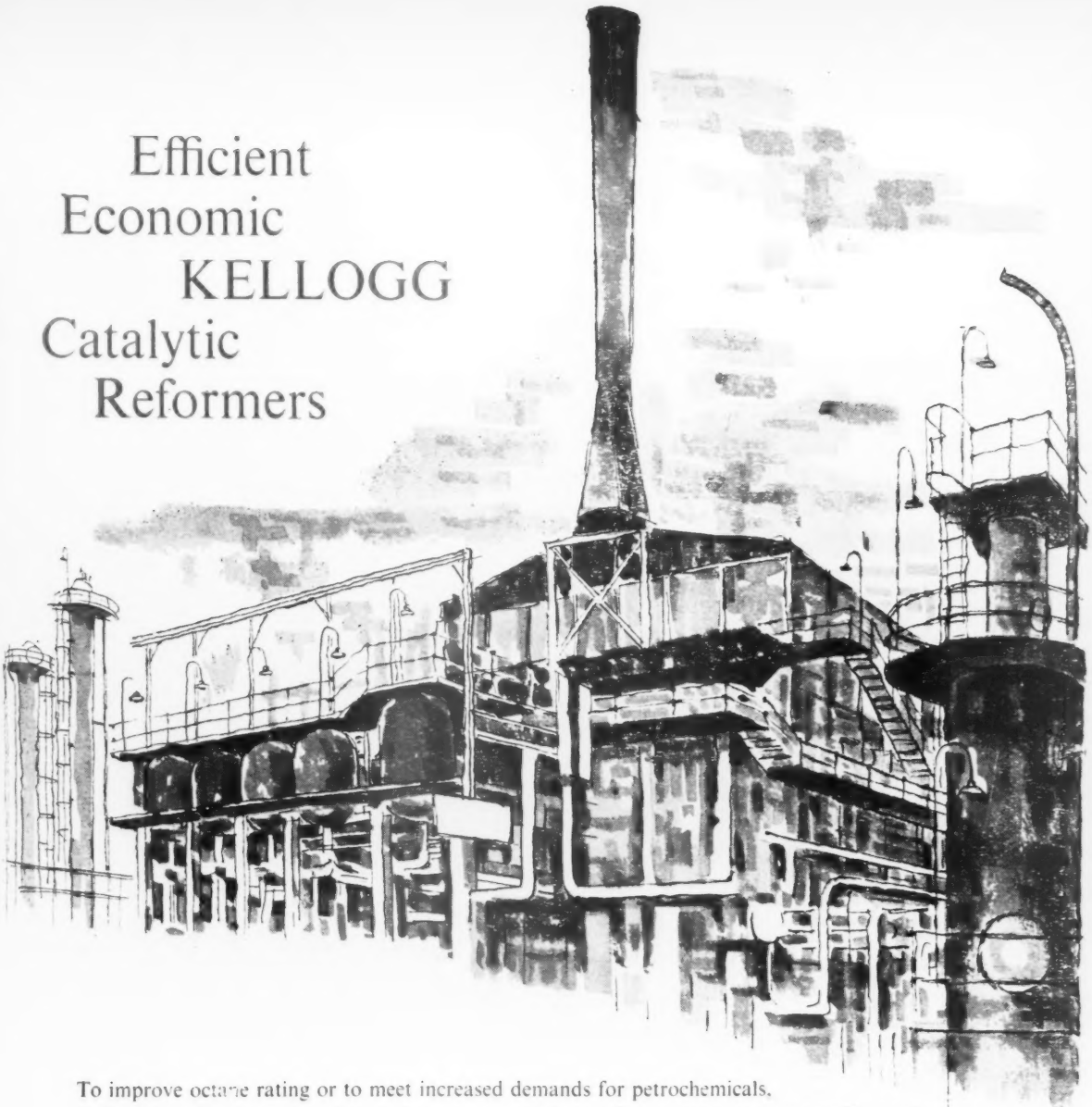

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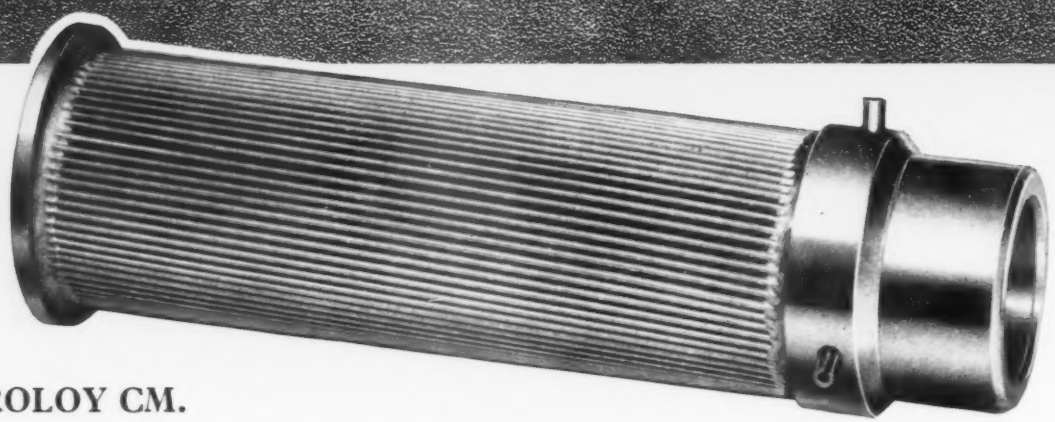

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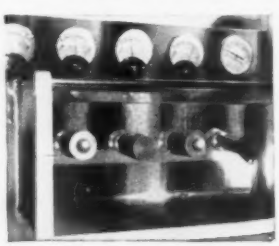

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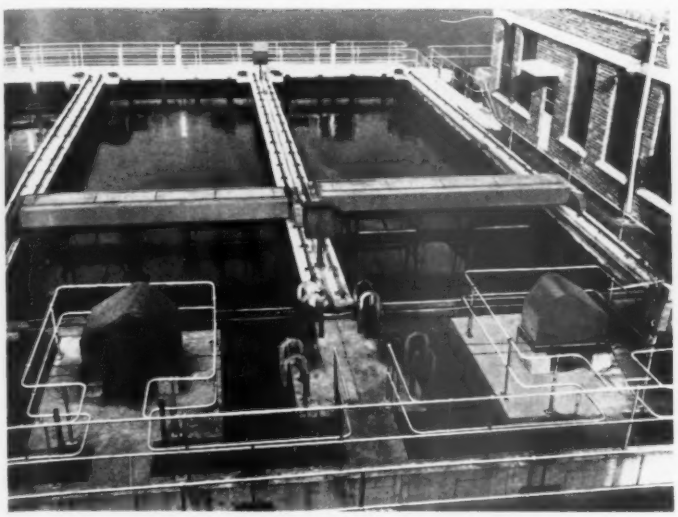

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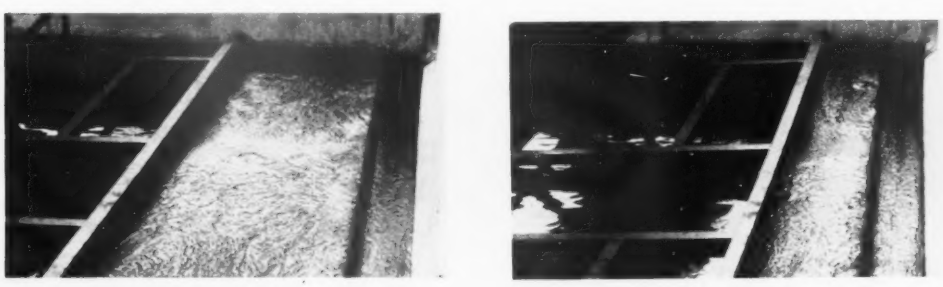

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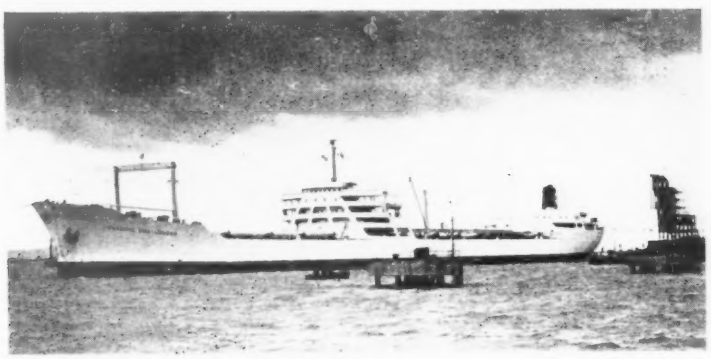

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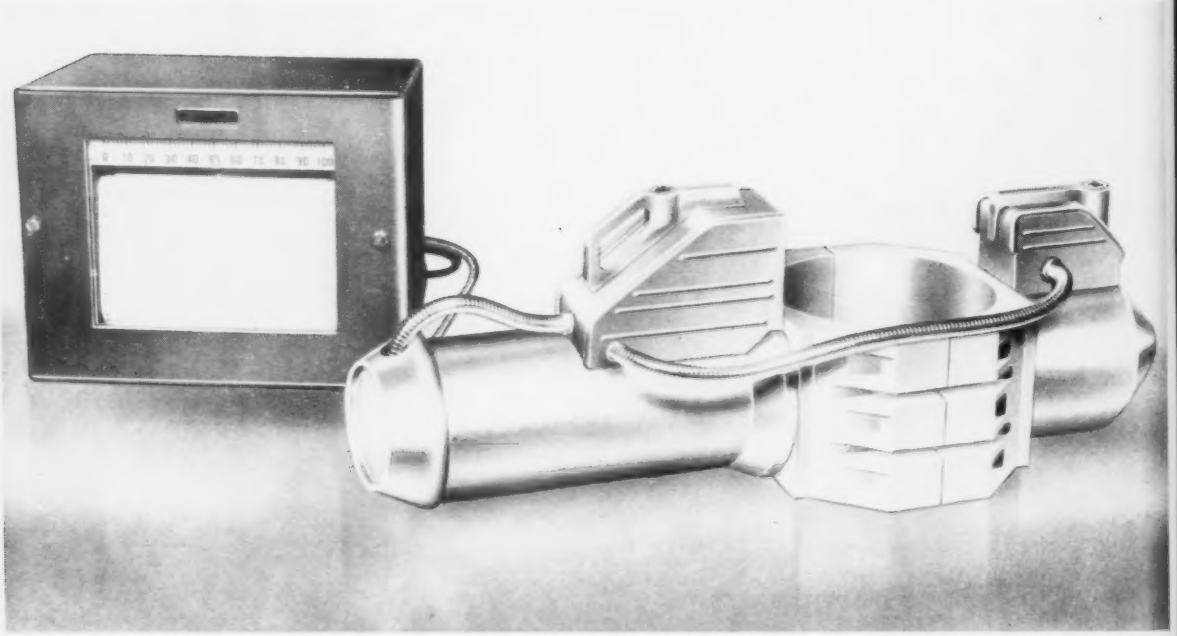

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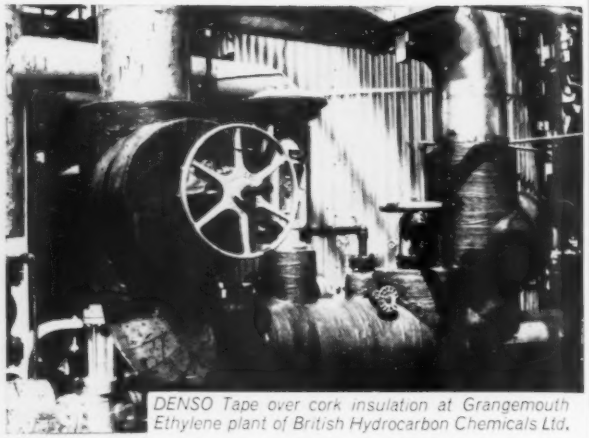

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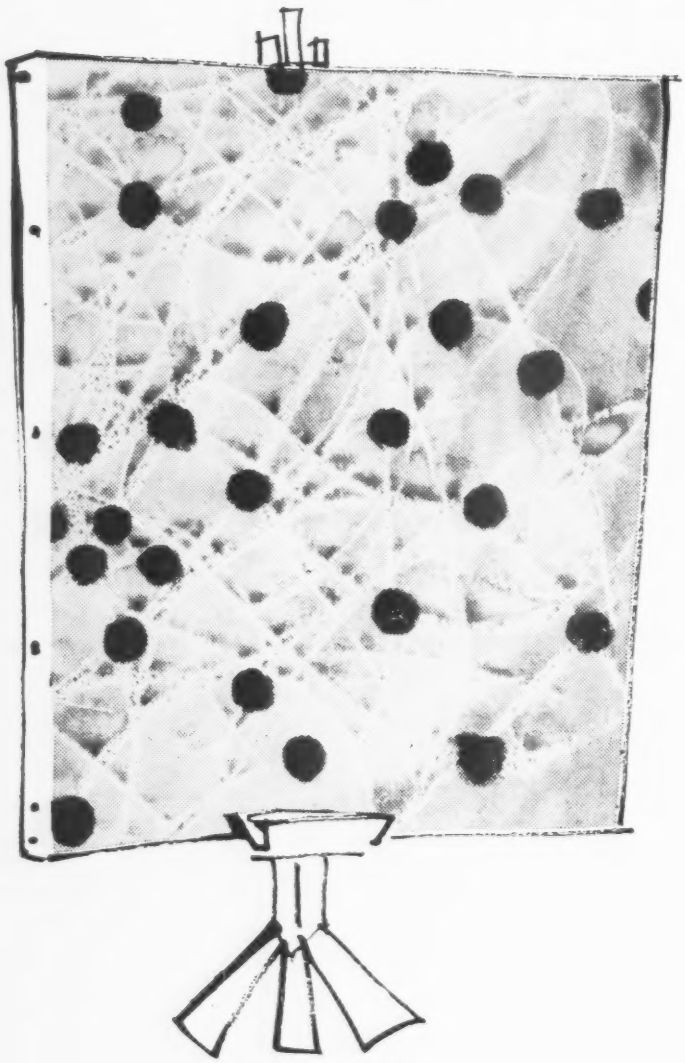

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Volume 15, No. 177 September 1961

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# Why Are Oil Reserves Continually Growing?

*This was the title of a symposium held by the Exploration and Production Group of the Institute on 23 June 1961. The introductory talk and the first of the four papers presented at the symposium are published in the following pages. The three remaining papers will be published in succeeding issues.*

## *The Facts as Borne Out by Statistics*

*By* E. V. CORPS*

This introduction is designed to set the background for the papers and discussions which follow on the subject "Why are oil reserves continually growing?" It is an attempt to show, as clearly as possible, the magnitude of the world's crude oil reserves, where they are located, and how they have changed in magnitude and location over the past few years. Naturally some reference will be required to the relation between reserves and crude oil production and demand, but the main assignment is to discuss reserves, and it is not intended to elaborate on these other fascinating aspects of the oil industry. What follows is confined strictly to presenting statistics, and explaining the factors which control them. No attempt is made to speculate on the conditions which led to these factors, nor on future trends and possibilities. These are for other contributors to the symposium to deal with.

First, however, what are the facts? It is not known how many different estimates of reserves there are to choose from, nor which is the most reliable. Given the opportunity of making an independent assessment I do not suppose that any two people would come up with the same answer. It is proposed, therefore, to use as the basis of the accompanying charts the statistics published annually by *World Oil* in its 15 August issue. Where figures are not available from this source, as for instance for 1960, they have been taken from the *Oil and Gas Journal*. The *World Oil* production unit is the U.S. barrel. No doubt this will not please everybody, but it is the unit in which more oil statistics are published than any other. Perhaps the most

*Growth of world crude reserves* 1938–1960
*(At year end in thousand million brl)*

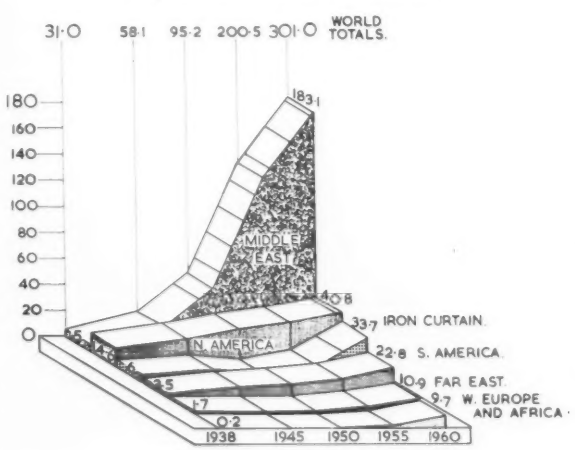


*Fig* 1

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satisfactory unit technically is the cubic metre, and it would have been a simple matter to have converted the figures into these units and satisfied nobody. Figures for natural gas are not dealt with in this paper, and although this is a pity, there are no comparable data easily available.

**Reserves Since 1938**

The total world crude reserves at the end of 1960 were estimated at 301,002,500,000 U.S. brl. Fig 1 shows how this is made up and how its make-up has changed since 1938. It will be seen that the reserves are now ten times what they were in 1938. This increase is dominated by the emergence of the Middle East, where estimated reserves have increased from just over 5000 million brl in 1938 to over 180,000 million brl in 1960, a 36-fold rise. For the rest of the world the increase is from 26,000 million to 118,000 million brl, about 4½ times.

Fig 2 shows the changes in the percentage share of the crude reserves over this period. The share of North America, the figures for which are still dominated by the U.S.A. despite the large reserves proved in Canada in recent years, has fallen from nearly one half the total reserves of the world in 1938 to 13 per cent at the end of 1960. The Middle East share has climbed from 17 per cent to over 60 per cent.

*Percentage share of crude oil reserves*

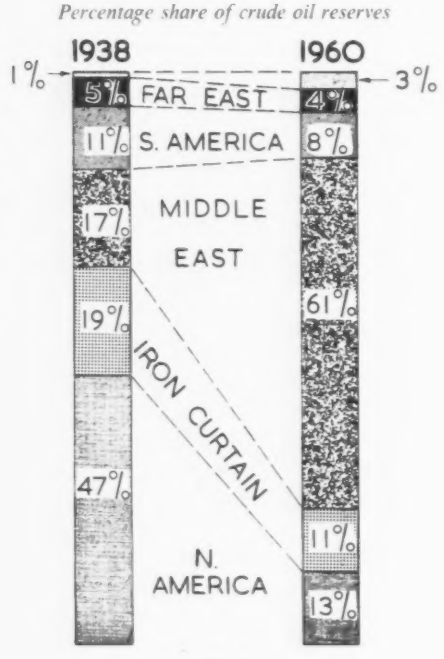


*Fig 2*

The Iron Curtain figure may well be the one to watch, however. During the past 5 or 6 years the actual level of reserves from these countries, of which all but a very small fraction represents the reserves of the U.S.S.R., has increased to a very large figure, and has represented a persistently increasing share of world reserves (Table I).

Fig 3 shows the last decade in a little more detail. Here can be seen clearly the real emergence of the Middle East

*Growth of world crude reserves* 1950–1960
*(At year end in thousand million U.S. brl)*

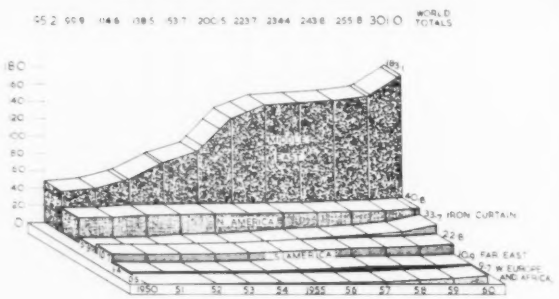


*Fig 3*

as an overwhelmingly dominant power in the realm of oil reserves. The climbing figures of the Iron Curtain countries can also be seen. Having already passed the South American group, they are rapidly overhauling those of North America. In fact some observers would consider that this has already been done. The Sahara reserves are also shown on a realistic scale.

In order to indicate some of the milestones in this period of development it is necessary to use another set of figures which take into account the annual production of crude. Fig 4 shows annual production for the period 1950–1960. Production has doubled, from 3800 million brl in 1950 (10½ million bd) to 7700 million brl in 1960 (21 million bd). In 1938 it was 2000 million brl (5½ million bd), only just over one quarter the present figure. North America still leads in production and has increased by nearly 800 million brl/year (over 2 million bd). But the spectacular increases are again those of the Middle East and the Iron Curtain countries.

What the symposium is really interested in is the amount of new oil found year by year. This is obtained by computing for the end of each year and figures for the total ultimate recoverable oil; *i.e.* the reserves available plus the cumulative production which has been removed to date. The annual increments in these figures give the amounts of new reserves added each year, and the world totals are shown on the graph of Fig 5. These additions to reserves are made up of new oil pools discovered, both on new structures and at hitherto unexplored horizons in established fields; of increased recoveries from established pools, *e.g.* by secondary recovery; and by re-assessment of earlier estimates. The re-assessment of estimates is not always upwards, and some of the individual figures from which this chart is compiled do, indeed, show a drop in reserves. Note the relation of these figures to the level of production at various times—2000 million brl in 1938, 3,800,000 million brl in 1950, 7700

TABLE I

IRON CURTAIN COUNTRIES' SHARE OF CRUDE RESERVES

| | *Per cent* | | *Per cent* |
|---|---|---|---|
| 1955 | 6·4 | 1958 | 8·5 |
| 1956 | 7 | 1959 | 9·5 |
| 1957 | 8 | 1960 | 11·0 |

*Crude production* 1950–1960

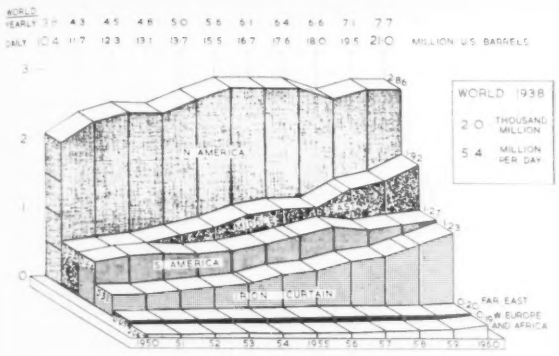
WORLD
YEARLY 3·1 4·3 4·5 4·6 5·0 5·6 6·1 6·4 6·6 7·1 7·7
DAILY 10·4 11·7 12·3 13·1 13·7 15·5 16·7 17·6 18·0 19·5 21·0 MILLION U.S. BARRELS
WORLD 1938
2·0 THOUSAND MILLION
5·4 MILLION PER DAY
N. AMERICA
S. AMERICA
IRON CURTAIN
FAR EAST
W. EUROPE AND AFRICA
1950 51 52 53 54 1955 56 57 58 59 1960

*Fig* 4

*New crude reserves added each year*
1939–1960
*(Thousand million U.S. brl)*

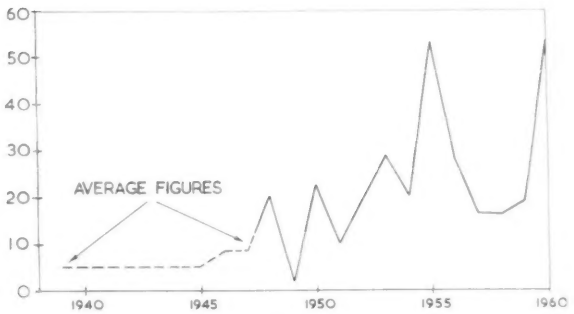


*Fig* 5

million brl in 1960. In every year the volume of new reserves added has been greater than the volume of production taken, except for 1949, which is a "statistical" freak sandwiched between two high years.

**Regional Reserves**

Fig 6 shows these increments apportioned to different areas. As far as the North America figures are concerned, the steady annual addition is a reflection of this same trend in the U.S. In the U.S., new reserves have been added at a remarkably constant rate of about 3500 million brl/year throughout the period 1950–1960. For 1960 itself, early figures suggest an increment of nearly 4400 million brl. These figures compare with an annual production of 2300–2600 million brl. The remarkable thing about these additions to reserves is that they have been achieved with negligible reliance on major new discoveries. In the figures which go to make up this chart, taking a probable total ultimate recovery of 100 million brl as representing a major field, there have been only two such fields since 1953. There have been important Canadian discoveries, including the Pembina field in 1953 which is said to be North America's largest field in areal extent, and the Swan Hills discovery in 1956 which has recently been described as the biggest North American discovery since East Texas.

In South America, Venezuela occupies a dominant position similar to that of the U.S. in North America, especially from 1953 on. The granting of new concessions in 1956 (after a 10-year hold-up) has resulted in marked increases from the Lake Maracaibo area from 1957 on. Locally important additions in Colombia (1954) and Argentina (1959–60) scarcely show up on this chart.

The West Europe and Africa figures include additions resulting from the discoveries at Sudr (1946) and Asl (1948) in Egypt; Lacq (1949) in France; Schoonebeek in Holland and Parentis in France (1954/55); and Belayin in Egypt (1955). The Saharan fields appear in 1957 and Libya in 1960. West German reserves, which are important but without the spectacular character of the discoveries from other European areas, have contributed continuously.

So far as the Iron Curtain Countries are concerned it is not possible to make any useful comment. Some people would consider they are an under-estimate. A recent article in the *Petroleum Times* quotes a Soviet source for a figure of 9600 million tons recoverable reserves, *i.e.* something in the order of 70,000 million brl, or more than twice the figure used in Figs 1 and 3.

In the Far East, 80 per cent of the oil occurs in Indonesia, and it is the development of the Minas field of Central Sumatra (1944) and discoveries associated with it which form the bulk of the reserves added in this area. India has made small but discernible contributions in 1954/1955 attributable to the Assam Valley fields discovered in 1952 and in 1960 as a result of the Oil and Natural Gas Commission's discoveries in Cambay and Ankleshwar.

Now to the Middle East. It is not possible to apportion to individual fields, or even countries, the very large and fluctuating additions to reserve estimates in this area. For various reasons, fields are often not put to production until

*Areal distribution of new reserves added each year*
*(Thousand million U.S. brl)*

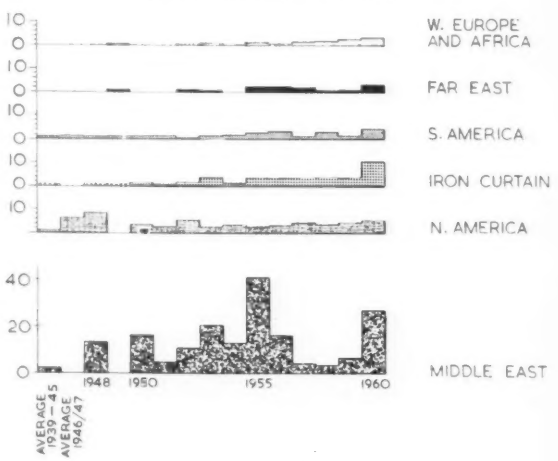


*Fig* 6

*Spare producing capacity as a percentage of total capacity*

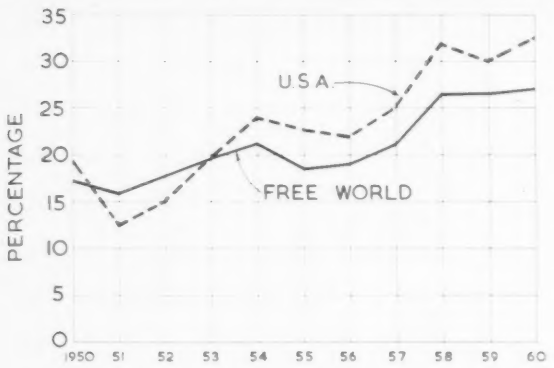


*Fig 7*

some time after discovery, and subsequently exploitation and extension of these fields adds to the reserves of each field year by year, almost without exception. The fields themselves are prolific, and their reserve estimates change on a correspondingly prodigious scale. Two or three changes which happen to coincide in one year send Middle East figures rocketing, to be followed by a period of comparative quiescence, say of some mere 5 or 6000 million brl—as much as the additions for the whole of the Western Hemisphere put together. The following fields have all made major contributions during the 11 years covered by this chart: discovered in 1939, but by no means fully proved by 1950, the Ain Zalah field of Iraq; discovered in 1940, the Dukhan field of Qatar enters the reserve figures only in 1950; discovered in 1948, the Ghawar field of Saudi Arabia, and in 1949 the Zubair field of Iraq. Fields actually discovered within the period 1950–1960 include:

PRODUCTION
(million U.S. brl annually)

| | |
|---|---|
| U.S.A. ... ... | 2,568 |
| U.S.S.R. ... ... | 1,083 |
| Venezuela ... ... | 1,042 |
| Kuwait ... ... | 594 |
| Saudi Arabia ... | 456 |
| Iran ... ... ... | 386 |
| Iraq ... ... ... | 353 |
| Canada ... ... | 191 |
| Indonesia ... ... | 144 |
| Mexico ... ... | 99 |

| | |
|---|---|
| 1951 ... | Safaniya (Saudi Arabia) |
| 1952 ... | Magwa-Ahmadi (Kuwait) |
| 1953 ... | Rumalia (Iraq) and Wafra (Neutral Zone) |
| 1954 and 1955 | Additional pools in the Wafra Field (Neutral Zone) |
| 1955 ... | Raudhatain (Kuwait) |
| 1956 ... | Khursaniyah (Saudi Arabia), Qum (Alborz) (Iran) |
| 1957 ... | Sabriya (Kuwait), Manifa and Khurais (Saudi Arabia) |
| 1959 ... | Minagish (Kuwait) |
| 1960 ... | Sirip (Iran offshore), Khafji (Neutral Zone—Arabian Oil Co.) |

**The World Postition**

There is a classification employed by the higher levels of modern civilization and culture known as the Top Ten. In Table II this is applied to the world of oil production, reserves, and total ultimate recoverable oil. I find that the interesting participants are those which make only one appearance. Mexico, which is still one of the world's great producing countries; Algeria, which fills the last place among the rich oil reserve countries; and Canada, just nosed out by Algeria in the reserve classification by a disputable decimal point, which comes into the countries with the greatest ultimate recoveries.

The concern of this symposium is with the long term maintenance of oil supplies, which is at the moment in a happy situation. Indeed, it can be said, strictly ignoring any speculation as to future trends, that up till now the rising trend of reserves has opened up year by year an increasing gap between it and the rising trend in demand. The day to day availability of oil supplies, however, is the problem which is most publicized both within the industry and outside at the present time. The chart of Fig 7 is taken from a paper delivered to the Petroleum Engineers at the Annual Meeting of the AIME in St Louis in February 1961 by Zeb Mayhew, of the Standard Oil Company (N.J.). It shows the spare producing capacity as a percentage of total producing capacity for the U.S. and for the Free World. On these figures Mr Mayhew comments "The U.S. had two periods of substantial growth in spare production; the first following the Korean war when it increased from about 15 per cent of capacity to nearly 25 per cent, and the second following the Suez Canal crisis when spare production grew to 30 per cent. The free foreign areas (which Mr Mayhew shows separately in addition to the graphs shown here) with a dip during the period of large growth in demand from 1953–1957, have remained fairly close to 20 per cent throughout the 1950's, while overall the free world, weighted heavily by the U.S., has grown from 18 per cent to 27 per cent. "Studies have indicated", says Mr Mayhew, "that broadly speaking, 15 per cent is adequate for operational contingencies and anticipated growth; a level of about 20 per cent should be sufficient to handle most emergencies, and anything more is probably a burden, even if prices are not adversely affected. Naturally, if spare capacity weakens prices, any level soon becomes burdensome."

TABLE II

THE TOP TEN

| RESERVES (thousand million U.S. brl) | | GROSS ULTIMATE RECOVERABLE OIL (thousand million U.S. brl) | |
|---|---|---|---|
| Kuwait ... ... | 62·0 | U.S.A. ... ... | 99·0 |
| Saudi Arabia ... | 50·0 | Kuwait ... ... | 66·0 |
| Iran ... ... | 35·0 | Saudi Arabia ... | 54·0 |
| U.S.A. ... ... | 34·0 | U.S.S.R. ... ... | 44·0 |
| U.S.S.R. ... ... | 31·5 | Iran ... ... | 39·0 |
| Iraq ... ... | 27·0 | Venezuela ... ... | 32·0 |
| Venezuela ... ... | 18·5 | Iraq ... ... | 30·0 |
| Indonesia ... ... | 9·5 | Indonesia ... ... | 12·0 |
| Neutral Zone ... | 6·0 | Canada ... ... | 6·5 |
| Algeria ... ... | 5·2 | Neutral Zone ... | 6·0 |

To conclude, Fig 3, relating to the growth of crude reserves during the past decade, shows that total reserves at the end of 1960 were about 301,000 million brl, that is to say enough for 40 years production at the present rate. It is interesting to note that, from the latest figures of world population, our share of this is about 10 barrels each.

# Geological Considerations

By G. D. HOBSON*

Additions to known oil resources are the result of team work. They arise in a number of different ways: from searching more deeply; from exploring new areas, some of which were hitherto not easily accessible; from applying fresh ideas in old areas; from more efficient production methods; from the better interpretation of well data, and missing less that might lead to production.

Growing consumption of oil fixes the necessary producing rates, and the attainment of these rates depends on there being adequate reserves, and especially on oilfields in a youthful producing condition. The building up of an adequate amount of oil reserves calls for exploration, and for a variety of reasons it is desirable that the developed resources should be spread widely.

Decisions to search for and to develop oil and gas fields are based on the consideration of a number of factors. These factors are geological, geographical, economic, political, and the techniques available (for locating possible traps, and for testing and developing any oil or gas accumulations found in them). Some of these factors are interrelated; others are independent; some change over time, sometimes quickly and in an unpredictable manner.

The geology of an area controls the occurrence of oil and gas. It is a fixed factor. However, knowledge of the geology grows and depends on the techniques available for obtaining information. There is also evolution of thought on the mode of occurrence of oil, and of the means available for interpreting data.

### Fresh Ideas

As time goes on, the geologist widens his outlook on possible types of trap. Increase in well information may permit re-interpretation of geophysical data, possibly improving some prospects and down-grading others. Undoubtedly, the correct evaluation and interpretation of well data have been important guides to discoveries, and these activities will increase in importance. Correlation and other means for discerning palaeogeography, palaeogeology, and structural evolution are invaluable.

The idea of hydrodynamic accumulation of oil was emphasized by M. K. Hubbert some years ago. As a result, electrical model studies have been based on subsurface pressure data, presumably with the intention of determining flow patterns and thus the likely direction of displacement of accumulations. The problem is complex, and it is not clear whether success has attended this approach.

Oil accumulations in basement and in igneous rocks have long been known, but the large accumulation of oil in "granite" at La Paz undoubtedly focused attention anew on this kind of accumulation. As a result, wells have been drilled deep into basement in other areas. The lead at La Paz came from discrepancies indicated by material balance studies. Globally, oil in basement rocks accounts for but a small proportion of the reserves in major fields (Table I),

TABLE I

| *Lithology of reservoir rocks* | *Reserves—10⁹ brl* | |
|---|---|---|
| | *Free World* | *Middle East* |
| Sand, sandstone ... ... ... | 128·1 | 68·9 |
| Limestone, dolomite ... ... | 87·3 | 70·9 |
| Fractured shales, igneous and metamorphic rocks ... ... ... | 1·6 | — |

After Knebel and Rodriguez-Eraso

and the same appears to be true for the smaller fields.

Esso's recently acquired exploratory licences in southern England are seemingly based on ideas derived from developments in other areas.

It is well known that given areas are characterized by a predominance of certain types of accumulations: limestone reefs in parts of Canada; large anticlines with thick limestone reservoirs in Iran and Iraq; strong anticlines with thick productive series in some sectors of California. There is, nevertheless, a range of types of traps in some not very large areas, *e.g.* parts of California, and there can be various types of accumulation on a single unit, as at Kraft-Prusa in Kansas.

Fashions occur in the search for oil. Thus geologists may become reef conscious, shoreline conscious, or fracture conscious, and for a time ideas of this kind can be fruitful in the appropriate areas. These ideas are not necessarily new to the oil world as a whole, but for a variety of reasons they may become prominent, even though accumulations (not necessarily large) of the given type may have long been known. In Western Canada the Leduc reef discovery sparked off a search for similar reefs.

In the early stages of the exploration of a new area, the search may be biased in favour of the discovery of oil in traps associated with structure, or with what may initially be assumed to be structure. Sometimes the search is successful, in a sense, for the wrong reason.

Perhaps there is wisdom in the use of the non-committal word "anomaly" for the geophysical indications on which wildcats are sometimes sited. The weaker anomalies in particular may have several possible explanations: there may be a patch of high-velocity beds in the sequence, a buried hill, or slight warping. Some may be spurious from an oil accumulation angle. In Western Canada glacial till or other overburden can be a source of phenomena which create, or give a distorted picture of "low-relief" features, and drilling on many of these has yielded no oil or gas. Single wells may, however, not always give unequivocal answers about the presence or absence of a trap, as distinct from the presence or absence of oil at the locality in question.

Also in Western Canada, irregularities on the post-Palaeozoic erosion surface have given rise to seismic anomalies which have been interpreted as folds rather than as buried topography. Drilling on some of these has, nevertheless, had some success because of erratic stratigraphic conditions

*Imperial College of Science and Technology.

TABLE II

| *Area* | *Number of major fields* | *Average ultimate in million brl* |
|---|---|---|
| North America ... ... | 177 | 300 |
| South America ... ... | 28 | 730 |
| Europe ... ... ... | 1 | 120 |
| Middle East ... ... ... | 21 | 6700 |
| Africa ... ... ... ... | 1 | 200 |
| Far East ... ... ... | 8 | 520 |

These fields were stated to have 217,000,000,000 brl of oil, which was estimated to be 82·5 per cent of the Free World reserves.

in Mesozoic sandstones associated with ridges, scarps, or other eminences on the unconformity.

Sometimes the geologist has been led on by a series of finds to get production at sites which would be viewed with grave misgivings as the possible places for an initial test. Yet when the reasons for the accumulations are understood, it is realized that the sites are logical, although far from easy to foresee. Lenticular conditions in Trinidad have led to accumulations occurring in synclinal areas.

It appears that for the Spraberry trend of West Texas the first indications of oil in the Permian reservoir rocks were obtained in drilling on a dome with the Ellenburger as the objective. Some years later another Ellenburger well had a Permian show which, on testing, resulted in a producer. Comparable finds followed considerable distances away, in some cases in plug-backs from the Ellenburger. These led to the idea of a shoreline trend, and a spate of wildcats followed in an area 150 miles long and 50 miles wide. Then some wells succeeded up dip of the previously indicated belt, without close reference to the "shoreline trend", and detailed studies showed that fractures in the Middle Permian producing series were an extremely important factor in this area. Seemingly, without fractures the Spraberry would be too tight to be a satisfactory reservoir rock. There are oblique fractures and shattering in siltstones; black shales, which constitute much of the Spraberry, have vertical fractures, and act as reservoirs in part.

TABLE III

| | *Percentage of fields Estimated ultimate recovery in million brl—not over:* | | | |
|---|---|---|---|---|
| | 25 | 50 | 75 | 100 |
| | % | % | % | % |
| California ... ... | 15·0 | 38·7 | 47·3 | 54·1 |
| East Texas, Texas Gulf Coast, Southwest Texas | 34·7 | 61·1 | 71·1 | 77·6 |
| West Texas ... ... | 40·1 | 62·2 | 72·1 | 81·1 |
| Louisiana ... ... ... | 40·9 | 67·9 | 77·7 | 82·9 |
| Colorado, Wyoming, Montana, North Dakota ... | 53·2 | 69·7 | 79·6 | 88·1 |
| Appalachian, Kentucky, Indiana, Illinois, Michigan ... ... ... | 59·6 | 72·2 | 78·4 | 80·8 |

The U.S. oilfields considered in the above tabulation were those which in 1960 produced 1000 brl per calendar day, or 3000 brl per allowable day in Texas; however, all major fields are included.

### Oil Richness

There is evidence of great differences in the oil richness of various regions, both as regards the amount of oil and the size of individual fields. Knebel and Rodriguez–Eraso's studies of major fields (reserves exceeding $100 \cdot 10^6$ brl each) in 1955 showed those of the Middle East to be on average larger than the major fields known elsewhere (Table II).

An analysis of data for U.S. fields shows that for fields giving 1000 bd or more in 1960, California had a greater proportion of large fields than other areas (Table III). Moreover, its major fields had an average size which was larger than in the other important oil-producing states (Table IV).

The degree of oil richness in a new area is a matter of speculation in advance of an adequate amount of drilling. There may be indications of large structures, but the properties and extent of any reservoir rocks may be in doubt, as will be their oil content. At Hassi Messaoud the accumulation is below two unconformities, which introduce a lot of unknowns, and apparently on a very gentle, although large, structure. Without knowing the thoughts of those concerned with this discovery, it may be wondered how far events turned out strictly according to expectations.

### Exploration Activity

A discovery can lead to increased vigour in the search for oil, especially when, as a consequence of the concession terms, territory becomes available to other companies.

A switch in the intensity of use of geophysics from U.S.A. to other areas is revealed by a comparison of data for 1953 and 1958 (Table V). Nevertheless, consideration of the number of wildcats drilled shows a large effort devoted to the continued search for oil in U.S.A. (Fig 1). In 1960 one well in five was a wildcat; in Colorado the ratio was 1 : 2·1 and in Wyoming 1 : 3; on the other hand some of the older areas had little or no wildcatting—Pennsylvania 1 : 29, Kentucky 1 : 52; New York and West Virginia had none.

The very large annual production in U.S.A. has prevented a marked rise in the remaining reserves in contrast with some other regions during the past 10 years. Yet $32 \times 20^9$ brl of oil were discovered (Table VI), but this important fact has not been in the headlines in Europe as has been the case for developments in some other areas.

TABLE IV

At the end of 1960 U.S.A. was reported to have 235 major fields with an aggregate ultimate of 58,139 million brl of oil.

| *State* | *Number of major fields* | *Major field reserves—million brl* | *Average size in million brl* | *Percentage of State reserves* |
|---|---|---|---|---|
| Texas ... | 88 | 24,230 | 275 | 62·0 |
| California ... | 41 | 13,594 | 331 | 83·7 |
| Louisiana ... | 34 | 5,371 | 158 | 47·4 |
| Oklahoma | 21 | 5,283 | 251 | 50·8 |

TABLE V

DISTRIBUTION OF GEOPHYSICAL ACTIVITY

| | 1953 | | 1958 | |
|---|---|---|---|---|
| | *Seismic* | *Gravity* | *Seismic* | *Gravity* |
| | % | % | % | % |
| U.S.A. ... ... ... | 67·9 | 61·3 | 49·0 | 32·8 |
| Western Europe ... ... | 6·3 | 6·3 | 14·0 | 7·0 |
| Africa ... ... ... | 1·9 | 4·5 | 8·2 | 16·2 |
| Middle East ... ... | 0·6 | 3·6 | 4·6 | 5·2 |

The total world geophysical activity in crew-months was similar in 1953 and 1958.

The annual additions from new pools in U.S.A. are usually much less than the contributions by extensions and revisions (Table VII). A similar state of affairs has been observed elsewhere. Major fields may not necessarily appear as such at the time of discovery.

**Depth**

The search for oil goes ever deeper, because means are now available for drilling to greater depths than hitherto. Provided that unfavourable rocks have not been met, there is a temptation to explore deeper in oilfields on structures. The depth limit under these and other conditions, if not set by the reaching of unfavourable rocks, is fixed by the capacity of the drilling equipment, the purse of the operator, or the views of the geologist. In the U.S.A. the deepest well now exceeds 25,000 ft, and oil production has been obtained below 21,000 ft (Table VIII). It is likely that thirty years ago the Hassi Messaoud accumulation, for example, could not have been reached.

In only five states in the U.S.A. is the deepest well bottomed in basement; in three states the deepest well stopped in beds younger than the oldest producing formation in the state.

As the depth of search increases broadly the area of search must diminish, because of the wedging of the sedimentary deposits in the major basins.

Some twenty years ago Seyer stated that the maximum depth for an oil well should not exceed 20,000 ft, because at such depths the hydrocarbons would have been converted to gas, and semi-solids too viscous to flow. Presumably the reservoir which has yielded oil below 20,000 ft was once appreciably deeper. The condition of the potential reservoir rocks rather than the breakdown of oil may be the limiting factor to search at depth. There may be no single figure applicable to all areas, for the critical depth probably depends on the original characteristics of the rock, and on the setting, including the nature of the cover and the temperature gradients in that cover.

In parallel with the increase in geophysical activity there has been an increase in drilling in some areas outside the U.S.A. Moreover, the average well depth has increased (Table IX), but sometimes this trend is disturbed, possibly owing to a preponderance of exploratory wells in a total which itself is not high.

*Wildcats shown as a percentage of the total wells each year*

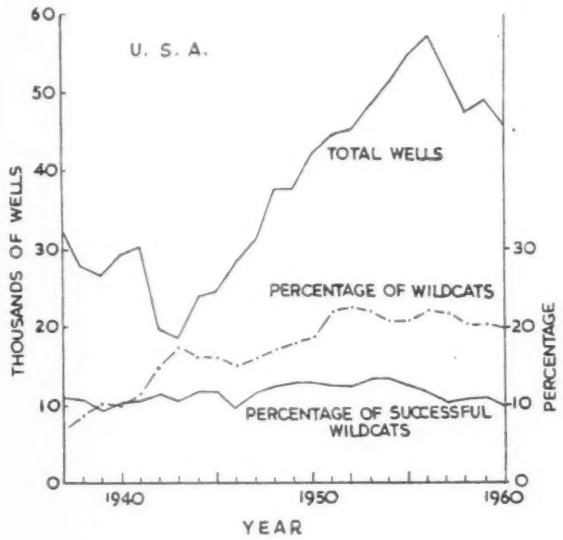


*Fig* 1

TABLE VII

ADDITIONS TO U.S.A. OIL RESERVES

| *Year* | *Total (thousand brl)* | *Proportions relative to new pools* | | |
|---|---|---|---|---|
| | | *New pools* | *Revisions* | *Extensions* |
| 1955 | 2,870,724 | 1 | 1·45 | 3·55 |
| 1956 | 2,974,336 | 1 | 1·72 | 3·64 |
| 1957 | 2,424,800 | 1 | 1·12 | 3·71 |
| 1958 | 2,608,242 | 1 | 3·03 | 4·25 |
| 1959 | 3,666,745 | 1 | 4·11 | 4·81 |

TABLE VI

OIL DISCOVERED (PRODUCTION PLUS INCREASE IN RESERVES)

1 JANUARY 1951 TO 1 JANUARY 1961

| | *Thousand brl* |
|---|---|
| U.S.A. ... ... ... ... ... ... | 31,836,514 |
| Middle East ... ... ... ... ... ... | 99,398,268 |
| Africa ... ... ... ... ... ... | 8,198,989 |
| Western Europe ... ... ... ... ... | 1,601,178 |

TABLE VIII

| | *U.S.A. deepest well (in feet)* | *U.S.A. deepest production (in feet)* | | *U.S.A. deepest well (in feet)* | *U.S.A. deepest production (in feet)* |
|---|---|---|---|---|---|
| 1927 | 8,046 | 7,591 | 1938 | 15,004 | 13,266 |
| 1928 | 8,523 | 8,523 | 1943 | | 13,490 |
| 1929 | 9,200 | | 1944 | 16,246 | 13,503 |
| 1930 | 9,753 | 8,550 | 1945 | 16,655 | 13,520 |
| 1931 | 10,585 | 8,823 | 1946 | 16,668 | 13,778 |
| 1932 | | 9,710 | 1947 | 17,823 | 13,904 |
| 1933 | 10,944 | | 1948 | | 15,510 |
| 1934 | 11,377 | | 1949 | 20,521 | 15,530 |
| 1935 | 12,786 | 9,836 | 1953 | 21,482 | 17,892 |
| 1936 | | 9,950 | 1956 | 22,570 | 21,465 |
| 1937 | | 11,302 | 1958 | 25,340 | |

TABLE IX

| | 1950 | | 1956 | | 1959 | |
|---|---|---|---|---|---|---|
| | *No of wells* | *Average depth (in feet)* | *No of wells* | *Average depth (in feet)* | *No of wells* | *Average depth (in feet)* |
| U.S.A ... | 43,913 | 3,643 | 58,418 | 4,029 | 49,331 | 4,170 |
| Middle East | 74 | 6,427 | 164 | 5,961 | 217 | 5,543 |
| Western Europe ... | 509 | 2,868 | 979 | 4,860 | 1,100 | 5,408 |
| Africa ... | 86 | 3,580 | 154 | 6,043 | 405 | 6,887 |

**Offshore Drilling**

Access to new areas, which include offshore areas, has considerably increased the known oil resources, and will expand them further. Lake Maracaibo, California, the Louisiana area, and more recently such areas as the Gulf of Paria and Abu Dhabi in the Persian Gulf are examples of this kind of development. New types of transport and other facilities have opened up deserts, swamps, and marine areas for drilling for oil. Technical developments of an engineering nature and means for executing geophysical work in water-covered areas have made it economically practicable to venture offshore.

Seventeen offshore Louisiana fields had ultimate reserves estimated (at 1 January 1961) at an average of $70 \cdot 10^6$ brl each, whereas 134 onshore coastal fields in Louisiana averaged $48 \cdot 10^6$ brl each. These were fields giving 1000 bd or more in 1960. The comparison may not be strictly fair in all respects, but it suggests general similarity of the two groups of fields, which is not unexpected.

**Legislation**

Sometimes legislation or politics reduces the attractiveness of an area, and then attention is paid to other areas not affected by this drawback, but which were previously ranked lower for other reasons. On the other hand, the passing of legislation can encourage oil exploration, as happened in the United Kingdom.

**Recovery Factors**

The reserves are a function of the oil in place and the recovery factor. The geology of a field determines the amounts of oil and gas, the characteristics and extent of the reservoir rock, the pressure and temperature in the reservoir. In turn these give the possible primary producing mechanisms, and thus, in conjunction with economic considerations, the primary recovery factor. The feasibility of applying secondary recovery techniques and, therefore, the over-all recovery factor, also depend on the geology. Consequently the better the knowledge of the geology of a field, particularly early in its producing history, the higher may be the eventual recovery from it.

**The Present and Future**

At the end of 1960, world cumulative oil production was placed at $116{,}503 \cdot 10^6$ brl and the remaining reserves at $300{,}000 \cdot 10^6$ brl. The sum of these figures, which is the present indicated known recoverable oil, may be compared with L. G. Weeks' estimate of 2 million $\cdot 10^6$ brl for ultimate primary oil reserves, and a further $1\frac{1}{2}$ million $\cdot 10^6$ brl from secondary recovery.

World oil production of $7650 \cdot 10^6$ brl in 1960 was 7·5 per cent above the 1959 figure. An annual increase of 7·5 per cent over 10 years would give production of $108{,}000 \cdot 10^6$ brl in that period, a quantity which would markedly reduce the present figure for remaining reserves, but raises no serious problems if Weeks' figures are a reasonable guide to the position, and discovery rates follow the past general pattern.

**Bibliography**


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**Discussion**

Upon opening the discussion F. E. Wellings said that oil reserves were continually increasing because oil was first found in the minds of men. There was still no known physical method for detecting oil underground. The only test was still the drill, backed by the teamwork of many technologists who required essentially the vision and imagination, the courage and perseverance that was necessary to find oil. The recent discoveries in the Sahara were proof of this.

For as long as he could remember the U.S.A. had never had reserves equivalent to more than the present 13 years supply. In the last decade 4000 million tons of oil had been discovered there, and it had been predicted to Morgan Davies of Humble Oil that in the next 20 years a further 10,000 million tons would be found there.

The authors were asked, first, were the figures for estimated oil reserves which had been given based on oil in place calculations with an assumed recovery factor, or on pressure decline performance and material balance? It was well-known how the recoverable reserves at Hassi Messaoud had been reduced since production began from about 30 per cent of oil in place to about 6 per cent at present.

Secondly, was the geological division of North African reserves the same as in the Middle East where they were about equally divided between Tertiary, Cretaceous, and Mesozoic, and sandstones amounted to nearly as much as limestones?

Dr Hobson replied that the oil reserves figures had been taken from published sources, some of which were quite clearly stated as "oil recoverable", whilst one suspected that others referred to oil in place or something akin to that. He knew little about North Africa but a small specimen he had seen from a sandstone reservoir from Hassi Messaoud had a not particularly high porosity and permeability which might account for the scaling down in the figures of recoverable reserves.

In reply to a questioner who cited the opinion in academic circles that the future for career geologists was not good—which seemed to be disproved by what had been heard at the meeting—Dr Hobson pointed out that in certain countries there were difficulties for non-nationals in trying to obtain employment at certain stages. In several countries experienced geologists were required and not merely graduates. In Britain the scope for obtaining oilfield experience was limited, and graduates generally had to obtain this abroad.

A. N. Thomas (BP) remarked that published reserves figures included primary recoverable reserves—a percentage of the oil in place—plus those reserves which had been established as recoverable by secondary recovery methods. The term "ultimate recoverable reserves" perhaps should include a hypothetical figure for reserves which are recovered by secondary recovery methods not yet implied. The accurate calculations of these figures were not publicized by the companies concerned, but in certain countries, particularly in Canada, where conservation boards operate in collecting basic information from which calculations were made, it was possible to take the field reserves figures as reasonably reliable. The Conservation Board of Alberta, for example, published all the factors which are required by the petroleum engineer to calculate the amount of oil in place in the formation. It is also possible to attribute a recovery factor, which in some cases may be too high initially, and has to be scaled down as the observations on actual production are taken.

The estimate of Lewis Weeks, for the total ultimate reserves of the world of 1500 billion brl, was said by H. V. Dunnington to be slightly out of date. Weeks himself had recently raised his

## REDUCED SUBSCRIPTIONS FOR RETIRED MEMBERS

The Council of the Institute has been giving some thought to the possibility of introducing a special scheme for retired members to continue their membership at a reduced annual subscription, provided they have been associated with the Institute for a considerable period of time and have retired from a full-time position in the industry.

A scheme has now been approved and will come into force from 1 January 1962.

Any member of the Institute of Petroleum may apply to the General Secretary to continue his membership of the Institute at an annual subscription of £1 1*s* 0*d* per annum, whilst continuing to receive all the rights and privileges of full membership, providing the following conditions are fulfilled:—

(*a*) The member must have retired from full employment in the industry.

(*b*) The member must be 65 years of age and have been a member of the Institute of Petroleum for a period of not less than 20 years.

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total ultimate estimate for primary recovery to 2000 billion brl, this being his interpretation of the total amount of oil which would be produced in the future, including what had been produced in the past, and which was said to be really the only logical way of defining what the reserve was. Within this total reserve all manner of sub-categories were included: proved reserves, proved reserves of secondary recovery, and so on, but the ultimate reserves were limited, are finite, so obviously, the speaker pointed out, no matter how the proved reserves figures are manipulated, we are not increasing our total wealth. It was interesting to go from this 2000 billion brl total to get some sort of idea of the rate at which oil has been formed and accumulated in such quantities and in such places as make it economically producible. To take Lewis Weeks' estimate again: we could reflect that there was indigenous oil in rocks as old as the Cambrian, so there is something like 500 million years of oil formation to account for. This would give us an average of 80,000 brl per year of oil formed through geological time. From the Cambrian, of course, the rate of formation had not been constant. During some periods, and in some places, the rate of formation and accumulation must have been very considerably greater than this, in order to provide the world with its large fields. It was part of the exploration scientists' task to try to determine where these places were: what the times were when an exorbitant amount of oil was being produced; and thus to narrow down the search for the more profitable oil accumulations.

It would seem, concluded Mr Dunnington, that from the total reserve additions in recent years and from any sort of reasonable projection of demand requirements for this oil, that the world was in quite a favourable position. Normally reserves were referred to the current rate of consumption, and everything seemed fairly comfortable. It became less comfortable as soon as one reckoned with the possibility of doubling consumption over a ten-year period. This would only return to a state of comfort if it could be assumed that the rate of oil finding in the future (plus revisions of reserves figures) also were to be stepped up to this rate. The long-term picture was not so encouraging and should be investigated if the present increase in proved reserves were being contemplated.

Dr Hobson agreed that one was not really concerned with the reserve figure, but the rate at which oil could be obtained. In many areas the maintenance of the rate of output was largely dependent on having an adequate series of new discoveries, thereby obtaining fast production enabling the rate to be kept up at an acceptable figure. Therefore the question of taking the total reserves at any time and dividing by some assumed producing rate could not necessarily tell how long crude oil production would be possible. And it could be misleading, because fields tail off as soon as they get older.

The question of the recovery figure was also tied up with economics. If the price of oil went up, it might be profitable to produce fields which otherwise might have had to remain unproduced. There was no single figure other than the total oil in place that could be relied upon with certainty. Other figures were apt to fluctuate with technical and economic trends.

E. V. Corps was of the opinion that too heavy weather was being made over these reserves. The way in which they are made seems to him to be outside our province at the moment, so long as the changes in reserves could be relied upon the definition of "reserves" seemed to be a simple matter: the amount of oil which at the present date (and reserves must always have a date put on them) was expected to be produced in the future; not what had been produced in the past. It included both primary and secondary production, and if economic trends which would change the situation could be foreseen, they would also have to be allowed for.

He emphasized that the phrase he had used was "total ultimate recovery", not "total ultimate reserves". Perhaps it should have been "total ultimate expected recovery", which is the reserves plus production to date.

In his opinion, in the basic long run, reserves would continue to increase so long as the demand for petroleum increased. If it was found that atomic energy could be produced simply and would replace the demand for oil, then the reserves would be found, but the rate of discovery would go down. It was basically just a question of supply and demand.

On the question of the employment of geologists and geophysicists, P. E. Kent (BP) commented that the progress of exploration round the world had accounted for most areas to a remarkably large extent. Re-surveys would certainly be done, both geologically and geophysically, but the total demand for work in the field on that kind of basis had come down very sharply in the last few years, and one could not see that it would expand again. It was this sort of factor which indicated that the continuing expansion of the output of geologists, or maintaining it at the present level, was not really a desirable factor. Added to that was the fact that in the new territories European or Americans were not always acceptable. The situation in British universities would have to change quite appreciably.

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## U.K. OIL PRODUCTION

BP Exploration Company has been rewarded with several small but encouraging finds of oil recently in its exploration work in Great Britain.

The most recent discovery was at Glentworth, near Gainsborough in Lincolnshire, where a test well found oil in the coal measures at 3600 ft. At South Leverton in Nottinghamshire, where there was a find in the latter part of last year, further drilling is now in progress to find the extent of the oil accumulation. There are now four oilfields within eight miles of Gainsborough.

The Company has also had further successes in some of its established fields. A new deposit has been found at Egmanton, while several new producing wells have been completed on the Corringham and Gainsborough fields in Lincolnshire, which were first located in 1958 and 1959 respectively.

BP's English oilfields produced 85,281 tons in 1960 and output for the first half of this year has totalled some 52,000 tons. The main producing fields are Egmanton, Eakring and Duke's Wood, and Bothamsall in Nottinghamshire, with smaller quantities from Kelham Hills, Plungar in Leicestershire, and Gainsborough and Corringham in Lincolnshire. An extended production test of the Kimmeridge well in Dorset is also reported to making a useful contribution to the total oil production.

# Around the Branches

ABADAN, BAHRAIN, ESSEX, FAWLEY, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD, YORKSHIRE

## Trinidad Branch

*Annual Dinner*

The 23rd Annual Dinner of the Trinidad Branch was held on 15 April at the Bretton Hall Hotel, Port of Spain, Trinidad. The Branch was honoured by the presence of His Excellency the Governor, Sir Solomon Hochoy. Over 100 members and guests attended and were entertained beforehand to the music of the Trinidad Police Band.

*His Excellency, Sir Solomon Hochoy, and Dr A. L. Down, in conversation with Victor Stollmeyer*

His Excellency was the guest of honour, and among the official guests were Professor Whitton, Dean of the Faculty of Engineering of U.C.W.I.; Professor Purseglove, Dean of the Faculty of Agriculture, U.C.W.I.; K. W. Finch, Chairman of the Group of Professional Engineers; F. Clerk, President of the Shipping Association; Leon Taurel, President of the Trinidad Chamber of Commerce; R. Wrong, President of the Junior Chamber of Commerce; and the general manager of the Industrial Development Corporation, D. Weintraub.

The success of the Dinner was in no small measure due to the detailed organization by the Branch Committee and in particular by W. G. Poole, hon. secretary treasurer of the Branch.

The chair was taken by Dr A. L. Down, who, in his address, reviewed the possible future world energy requirements and the part that petroleum would play in fulfilling those requirements. He noted that in 1961 world oil reserves and natural gas reserves were higher than they had ever been despite record productions in the 1950's.

In reviewing energy and oil developments of the last century, he began by referring to Dr Young's patent of 1850 and traced the events leading to the change from coal to oil as the primary contribution of world energy, the development of electrical power, and now the young competitor—atomic energy. In discussing the various expert opinions, it was noted that the economic prosperity of the free world outside the Soviet Union and its satellite countries was based on the annual consumption of energy equivalent to 2250 million tons of oil, and that petroleum or natural gas supplied approximately one half of the total energy requirement. It was expected that world energy requirements for the future might increase at the rate of $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent compounded per annum. That coal could provide for this increase was unquestioned in terms of reserves below ground, but it was felt generally that atomic energy would be the major competitor of oil in the future. The versatility of oil over its competitors and near monopoly in certain energy requirements, *e.g.* transportation, was indicated. In the field of electric power, coal was a strong competitor with oil but in this instance atomic energy had shown a challenge. Oil had ousted coal in shipping and the question of whether atomic energy would replace oil in turn was a matter for fruitful discussion. Dr Down felt that the development of nuclear-powered motor cars or aeroplanes could experience serious design difficulties and an alternative form of energy provider might challenge oil in this field.

In his concluding remarks, he outlined the latest views of the experts on crude oil's part in energy requirements for 1975. In both the United States and Western Europe, energy requirements would increase, and in the former area crude oil consumption could be expected to increase to just over 5000 million barrels year and in the latter area to 2500 million barrels year by 1975. It was quite possible that atomic power might be more than welcomed to help carry the world energy load. Nevertheless, petroleum had two other important roles to play, namely, as a raw material for chemical production and as a premier supplier of lubrication requirements. In these fields, and independent of energy supply, petroleum was making a great contribution to world progress.

Dr Down concluded by saying that it was essential for the Trinidad petroleum industry to uphold its technically advanced position in order to maintain its present share of these petroleum markets and assured His Excellency and guests that the Branch members, representing all phases of activity in the industry, would continue to make their contribution as in the past—a contribution which had been by no means small.

In reply, Professor Whitton noted the Chairman's review of the next few decades of development in the petroleum industry and took the opportunity to indicate the part that the U.C.W.I. Faculty of Engineering must play in the future. Professor Whitton further indicated that whilst the Chairman's predictions for the next 10 or 20 years were probably correct it would be in the

# Trinidad Branch Annual Dinner

*These scenes from the Trinidad Branch Annual Dinner 1961 show: top left, the Branch chairman, Dr A. L. Down, addressing members and guests, while top right Leon Taurel, President of the Trinidad Chamber of Commerce, describes how the "Walls of Jericho" fell. Bottom left, L. R. de Verteuil is seen making his address of welcome to distinguished visitors and guests; and bottom right, His Excellency, Sir Solomon Hochoy, addresses members and guests at the conclusion of the dinner*

*The picture in the centre is a general view of the top table showing His Excellency, the Governor of Trinidad and Tobago as Guest of Honour, official guests, and Branch committee members*

following decades that atomic energy could become a much bigger challenger to oil as a provider of world energy for all purposes. Recent developments of fuel cell construction materials based on beryllium, silicon alloys, and stainless steel may provide answers to the safety factor problems required in atomic energy sources. However, Professor Whitton noted the record of the petroleum industry in the past and felt that future generations of this industry would also prove equal to the situation. He concluded by proposing the toast to the Institute of Petroleum.

*The view from Point Paloma, Manzanilla Coast, enjoyed by members of the Trinidad Branch on one of their recent geological field trips*

L. R. de Verteuil, a member of the Trinidad Branch committee, thanked Professor Whitton for his generous remarks and assured him of the full co-operation of the Branch members with the Faculty of Engineering of the U.C.W.I. In noting Professor Whitton's cautionary remarks on the development of atomic energy, Mr de Verteuil opined that the advancement of science within the industry would continue to thrive on competition and that there would be ample scope for all for many a long year to come. Mr de Verteuil then reviewed the activities of the Branch during the past year and noted the increased membership, which indicated the healthy condition of the Branch's affairs. Mr de Verteuil welcomed the distinguished visitors present as guests of the Branch and in particular expressed the pleasure and honour which the Branch felt at the presence of His Excellency Sir Solomon Hochoy, who was attending his first Institute Dinner as Governor of Trinidad. In conclusion, Mr de Verteuil welcomed guests from government, commerce, and other organizations, and asked members to rise and drink to the health of the guests headed by His Excellency.

Mr Leon Taurel, President of the Trinidad Chamber of Commerce, replied on behalf of the Guests. In an amusing and witty speech, he indicated the appreciation of Trinidad of the contribution of the oil industry to the economy and well-being of the island and to the technologists of the industry. He also noted and welcomed the greater interest being taken by oil companies in the meetings and luncheons of the Chamber of Commerce. After an inimitable rendering in the tongue of another W.I. island of what happened to the "Walls of Jericho", Mr Taurel closed with thanks to the Branch on behalf of the guests for a most pleasant evening.

Before the gathering rose, Sir Solomon thanked the Branch for their congratulations on his appointment as Governor and said that it was a real pleasure to attend their Dinner in that capacity, particularly since, in the past, he had for many years been closely associated with all phases of the oil industry, The Institute, the Petroleum Association, and the oil companies, and in his various capacities in the Government Labour Department he had been very closely associated with the fortunes and misfortunes of the industry.

Sir Solomon went on to say that he had been most fascinated by the Chairman's address and his predictions with respect to petroleum requirements, and whereas the Chairman had dealt with the subject on a world basis and not Trinidad in particular, he could only hope that what was true on a global basis would, at least in part, be true for the island of Trinidad.

Sir Solomon was very pleased to note that the Institute was entertaining that evening a number of prominent members of the staff of U.C.W.I., since, with the West Indies nation becoming independent, they would be taking on greatly increased responsibilities that could only be handled by well-trained citizens. It was, therefore, encouraging to see members of the Branch who were making a contribution with their technical skills to the welfare of the Island, getting together with the staff of the U.C.W.I. on whom much in the way of higher education for the West Indies would depend.

*A Review of Recent Meetings*

C. Hopping, who is a palynologist with Shell Trinidad Ltd, presented a paper entitled "A Botanist in the Oil Industry" to a well attended meeting of the Branch at which ladies were present on 24 February and introduced members to an aspect of the oil industry which, although it was probably least known to them, was one which proved to be extremely interesting. He made it evident that geologists have a very useful tool for correlation and the study of environments as a result of the investigations on fossil spores and pollen in the rocks.

*Geological Field Trip*

The next Branch meeting, held on 19 March, was devoted to one of the increasingly popular geological field trips. Twenty-three members and guests led by J. B. Saunders, senior stratigrapher of Texaco Trinidad Inc., enjoyed a 3-mile walk along the East Coast at Manzanilla to examine a part of the very fine cliff exposures in Miocene and Pliocene rocks. This classic section was called the Upper Caroni or Carbonaceous series by Wall and Sawkins, who measured it in detail

in 1860 during a survey for workable lignite deposits. Members were able to examine shell beds, current bedded and ripple-marked sands, small scale slump structures, lignite seams, and other features of interest. After a scramble over Pt Paloma, during which the ladies held their own in great style, the party walked inland through the forest to the buses, kindly loaned by Shell, T.P.D., and Texaco companies, and so on to the classic type locality of the Manzanilla Formation further down the coast. Here the party partook of a well earned swim and lunch. During the afternoon Brigand Hill was climbed for an excellent view of East Central Trinidad and the Nariva Swamp. The return bus ride through the Central Range to the South rounded off a 14-hour day.

*Cooling with Ambient Air*

On 24 March Dr W. M. Topp of Texaco Trinidad Inc. presented a paper to members at the Apex Club entitled "Cooling with Ambient Air". In introducing his paper, Dr Topp noted that in most large scale industrial units a substantial proportion of the capital outlay and plant running costs was allocated to the removal of heat, such as condensing vapours and cooling of products to storage. The conventional method, he said, was to use cooling tower water in tube and shell equipment. Cooling by air had come into prominence in the last 10 years, due mainly to lack of suitable water supplies and also, in some cases, had proved to be more economical than water.

Dr Topp pointed out that air coolers were first used on long distance steam locomotives and on gas-treating plants in arid parts of Texas. Satisfactory service on these plants led to wider use in the oil and pipeline industries, and in 1948 the first completely air-cooled refinery was erected in Texas.

For the large heat loads dealt with in oil refineries, air coolers were usually constructed with horizontal steel tube bundles and headers with axial flow fans passing air in an upward direction across the tubes. Dr Topp said that design of the coolers could vary considerably as the product mass flow rate, velocity, and temperature rise of the air could be varied to achieve an economic design related to first cost and operating costs. External fins on the tubes could increase the bare tube area ten to twenty times.

Since exit air temperatures were not important, air coolers were suitable for high condensing temperatures. As the desired fluid temperature approaches to within 30°–40° F of the ambient temperature an economic evaluation of the two alternative methods of cooling was necessary. Relative humidity was of importance in this respect since a dry climate with a substantially colder cooling tower water supply would favour water cooling.

One application in which air cooling had proved economic was to remove the bulk of the heat load using air and "trimming" to the desired temperature using a small water cooler. Fixing a design air temperature was important in a climate where air temperatures could vary widely over a year. One method used frequently in Germany was to design for an intermediate temperature and cool the inlet air during the summer months by spraying with water.

A third technique employed with air coolers used a closed circuit water flow. Condensate was circulated, cooling the material in a tube and shell cooler, and was in turn cooled in an air cooler. High water temperatures could be used without danger of scaling. Dr Topp said this system had been used for fuel oil cooling at one refinery in Trinidad in addition to straight air cooling of gas oil using a design air temperature of 95°F.

Dr Topp's able presentation was followed by a general discussion and an expression of their appreciation by those present.

*Visit to a Sugar Factory*

On 4 May, fifty-five members and guests, including the ladies, visited the Usine Ste. Madeleine Sugar Factory, where they saw the complete processing of sugar from the arrival of the canes at the factory to the crushing and extraction of sugar from the canes and the final separation of the raw sugar in centrifuges from the crystallized solutions of the extract. The residue of the cane, bagasse, is utilized for fuel purposes, whilst the excess is bundled for future use as fuel or exported for paper or board manufacture.

Despite a temporary delay due to a power failure, the visit was thoroughly enjoyed by all and the Branch was deeply appreciative of the kindness and hospitality of the management and staff of Usine Ste. Madeleine Sugar Co.

*Perforating*

At the Apex Club on 26 May, Messrs D. P. J. Holbrook and H. C. Devenish of Trinidad Oilfield Service Ltd presented a joint paper to the Branch on "Perforating".

The paper started by giving an outline of the history of oil well perforating since December 1932, when the first oil well was perforated with electrically fired bullets in California making a producer out of a well which was about to be abandoned. Development was traced up to the present day and included a description of the jet process introduced after the war. The improvements in cementing and other well completion practices which had been made possible by perforating were then dealt with before the basic theory of bullet and jet perforating was discussed.

In the authors' opinion, bullets and jets were not competitive but complementary, and the manner in which various well conditions such as casing, formation, well fluid, etc., would affect the performance of both were described.

It was said that evaluation of different charges and bullet perforators had always been a difficult problem and a great deal of money had been spent in endeavouring to devise a standard system. The present method of using Berea sandstone as test targets and the use of the "Well Flow Index" was considered a step in the right

direction but it was felt that this could be misleading unless all the relevant factors were known and understood.

An interesting discussion developed and the evening concluded with a well merited show of appreciation to the authors.

### Yorkshire Branch

On one of the very few hot sunny afternoons experienced in the north this year, the Yorkshire Branch members who could obtain the half-day off on 31 May were playing golf on the delightful Wetherby course. The organizers must have been very pleasantly surprised and perhaps a little embarrassed at the record entry.

*A. Furness, honorary secretary of the Yorkshire Branch, congratulating F. Millward, winner of the Newsome Gold Cup. Trevor Newsome is between them holding a replica of the cup*

This 18-hole Model Tournament is primarily an outing of the Yorkshire Lubricating Oil & Grease Trades Association, who kindly invite Yorkshire members of the Institute to join them. E. T. Newsome presented a special trophy last year to be awarded annually to the Branch member with the best round, and this was won this year by Frank Millward with a score of 70. The runner-up was A. D. Osler on 73.

Fifty people turned up to sample the most excellent lunch and typical Yorkshire ham and egg tea laid on by the Club catering staff, and of these fifty, forty-five actually started the course, but not all finished! The novice section was again well represented and this provided keen competition, especially as to who could lose most balls. Wetherby is an extremely pretty course, with the River Wharfe winding slowly round one side and forming a natural boundary to at least four holes. We did hear of one aspiring golfer who bought twelve new Dunlop 65's from the Wetherby pro, and finished with one ball and two eggs (waterhens)!

The main prize of the day, the Newsome Cup, was awarded to J. S. Chester, score 69, and the runner-up was G. H. Battye with a net round of 71. Anyone over fifty years of age was eligible to compete for Mr Aske's prize, the Veteran Trophy, and this was won by J. Turner with a score of 71.

Everyone was delighted to see E. Attwood, this year's President of the National Lubricating Oil & Grease Federation, who had made the journey the day before. His overnight rest must have done him a world of good, because he was in fine form. His really dazzling round of golf produced a net figure of 63, which was good enough to win him the visitors prize.

By the time the novices had wound their weary way round what seemed to them an interminable course, it was found that B. J. Turley had come out best with a remarkably low net score of 64.

After everyone had feasted, the trophies were presented by R. A. Barton of the Yorkshire Lubricating Oil & Grease Trades Association, whilst the IP prizes were presented by A. Furness, honorary secretary of the Yorkshire Branch.

Thanks were expressed to the organizers, particularly to chief marshal and scorer John Dixon, and Mr Attwood thanked the promoters on behalf of the visitors. Once again, in glorious weather, the Golf Tournament had been a resounding success.

### London Branch

It was announced at a recent Branch meeting that J. H. M. Clark was to be the new Branch chairman and D. M. Watson and C. A. Stradling had been appointed honorary secretary and honorary treasurer respectively.

D. W. Sullivan addressed the same meeting on the subject of "The Planning and Design of the Esso Refinery at Milford Haven". In his talk he traced the considerations which led to the decision to erect the refinery, to locate it in its present site, and to establish its design, capacity, and its special features. He went on to give an outline of the detailed planning and preparation that went into the project and made it a masterpiece of co-ordinated effort and careful timing. He explained how the lessons learnt in the construction of Fawley and Whitegate refineries had been adapted to meet the special requirements of the new situation.

Mr Sullivan's talk, both in presentation and content, was an admirable and outstanding example of a clear, informative, and highly interesting address. It was accompanied by a few well chosen slides and followed by a brief film of the construction work in progress on the refinery and jetty.

### South-Eastern Branch

Sixteen members of the Branch visited the Distillers Company's Research Department at Great Burgh, near Epsom, on 27 June. After a short speech of welcome, the party was divided into groups which were shown round by guides who gave an excellent description of the activities of all the sections visited. Great Burgh, in fact, turned out to be almost a warren of well-equipped laboratories linked by paths through well-tended grounds.

The visitors were shown over laboratories where research is carried out on high-pressure reactions and plastics and synthetic rubber manufacture. Other

laboratories inspected specialized in routine work and development on chromatography, spectroscopy, and instrumentation.

The great emphasis on safety throughout the establishment was especially noteworthy. The visitors were all issued with protective goggles to be worn in potentially dangerous areas, and the general precautions taken to avoid danger to personnel were very obvious.

Lunch was served in the new staff restaurant, a spacious, modern building set in the most beautiful part of the grounds. After an excellent meal, the more specialized questions from members of the party were answered by the research staff.

**Fawley Branch**

H. Hyams spoke on "Why International Measurement?" to a joint meeting of the Fawley Branch and the technical staff of the Esso Refinery Fawley recently. He said that he did not propose to talk about systems of weights and measurements but about the need for international uniformity so that in the oil industry the buyer and seller could talk a common language. To do this standardization was necessary. A standard, he said, is a criterion by which the quality of an article could be gauged. Standardization aimed at simplification and an improvement in the minimum qualities of goods.

In most countries, a national body looked after standardization and these bodies were linked through international organizations for the venting of views and the smoothing of international trade.

The United Nations set up the International Organization for Standardization (ISO) of which Technical Committee No 28 handles petroleum and products. As with all international organizations, progress was said to be slow. One great achievement was the issue of the joint ASTM IP Petroleum Measurement Tables which were accepted and used throughout the world for computing quantities of oil products. Other work on terminology, specific gravity, density, kinematic viscosity, flash point, etc., was in hand, but unless speedy progress was made, national standards not international standards would be set up, producing confusion rather than uniformity.

Mr Hyams said that it was only through internationally accepted standards of measuring both the quantity and quality of bulk products purchased or sold, that buyer and seller could talk the same language. It was only by international uniformity and improvement in methods and accuracy that real storage, transport, and distribution losses could be determined. Only by balancing the cash value of real losses against the cost of improved installations, which would reduce losses, could the capital cost be justified.

Although the IP and ASTM could be justifiably proud of their achievements in the field of international standardization, Mr Hyams considered that they had failed of late to show their leadership, especially in Europe. Only by closer personal contact with European counterparts could this trend be reversed.

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## ECONOMICS AND OPERATIONS GROUP

This Group is open to all members of the Institute who wish to take part in discussions on petroleum economics, distribution, transport, and storage. The only formality necessary is to notify E. Herbert at the Institute's office. Full details of the meetings of the Group will be forwarded to members, but the programme for 1961/1962 session is outlined below:

| | |
|---|---|
| 1961 | |
| 12 *October*. | **The Role of Pipelines in Product Distribution**, H. G. B. Nolan. |
| 19 *October*. | **Risk and Success in Oil Exploration**, D. O. R. Noble (*The British Petroleum Company Ltd*). (Joint meeting with the Exploration and Production Group). |
| 9 *November*. | **Business Decisions in the Russian Economy**, A. Nove (*London School of Economics*). |
| 14 *December*. | **The Petrochemical Industry in the U.K.**, H. P. Hodge (*Esso Petroleum*). |
| 1962 | |
| 11 *January*. | **Oil and the Steel Industry**, W. F. Cartwright (*The Steel Company of Wales*). |
| 8 *February*. | **The Outlook for the Gas Industry**, D. D. Rooke (*The Gas Council*). |
| 8 *March*. | **Developing Energy Policy in the Common Market**, L. Duquesne de la Vinelle. |
| 20 *April*. | **A Review of the Year**, D. A. Glen (*Shell International*). |

Members of the Group are encouraged to invite guests who may be interested in any of the Group's activities.

## LADIES' EVENING

It has been suggested that the wives of Members might welcome an opportunity to look over the home of the Institute, with its considerable architectural merits, and the place where the meetings of the Institute are held.

To this effect an invited "at home" is being held on 20 October 1961, when members and their wives will be able to avail themselves of the opportunity of looking around the Institute building, having tea, and attending a lecture on a subject that will appeal to ladies. The lecture will be a general semi-technical one on "Petroleum Products in Cosmetics", and will be given by T. A. Brock of Max Factor Ltd.

The Social Evening will commence with tea at 4.30–6 p.m., and guests will be able to look over the Institute during that time.

Owing to the limited size of the lecture hall, admission will be by ticket only. Each ticket will be a joint one to admit a member and a lady guest. It is stressed that *invitations are not for male members alone*. Admittance will be limited to 100 couples, and applications for the joint tickets should be addressed to the General Secretary of the Institute without delay.

# The 6th World Petroleum Congress

Members will by now have received the brochure of this Congress, to be held in Frankfurt from 19 to 26 June 1963.

Once again oil men and their wives will be gathering together from all over the world, but this time they will find a somewhat different type of Congress, at least as far as the arrangements for the technical sessions are concerned.

*Part of the modern centre of Frankfurt surrounding a tower remaining from the old city walls*

In the past the pattern of paper presentation at the various Congresses has remained more or less the same. There have been nine or ten sections and papers have been presented individually by the authors and then discussed from the floor. Sometimes the discussion has been stimulated by a Rappateur, sometimes the discussion has been mainly written, but the pattern has generally remained the same, and at each Congress four General Lectures on a broad theme have been given by authorities of international repute.

For the 6th Congress the Permanent Council has decided to make a number of alterations to the arrangements for the technical sessions, which they hope will add considerable variety and interest to the Congress, whilst retaining the best features of previous Congresses.

In the first place the German Organizing Committee have found it possible to arrange simultaneous translation for all discussions. One of the great disadvantages of international congresses, and particularly of congresses the size of the World Petroleum Congress, has been the tedious, though necessary, intervals when the various interpreters were explaining the salient points of members' contributions in the other languages. At the 6th Congress a system of transistor wireless receivers will be used and all discussions will be translated into French or English and German. The German language (as the host country) will be used in the discussions, but not in presentation, which is confined to the two official languages, English and French.

The second innovation is that whilst the Congress will continue to be run under technical sections, and papers presented in the usual way, a considerable part of these Sections will be organized as Panel Discussions (Symposia is the usual description in Britain) when several papers will be grouped under interesting topics within the Sections.

Another change in the pattern of running of the Congress will be the reduction in the number of General Lectures and the introduction of Review Papers. These will each be given by an international authority and are intended to review very broad aspects of technology, to enable those who operate in other fields to be brought up to date in general developments between Congresses.

The four main themes of these Review Lectures will cover Exploration, Production, Refining, and Utilization and both the Review Papers and the General Lectures will be given in the mornings, when no sessions are in progress.

The usual attractive tours, both technical and sightseeing, will be arranged; the former before and after the Congress and the latter during the middle weekend. Frankfurt itself is a most attractive town and is a wonderful centre for sightseeing tours embracing the Rhine in one direction and the Black Forest in the other.

The Institute will be appointing a company as its travel agent and it is hoped in due course to inform members regarding travel arrangements at cheaper rates, and also to give a full list of times and fares on all the various routes and methods of transport to and from Frankfurt.

The Institute of Petroleum will once again run a combined bureau and lounge and all information about the Congress will

*Beside the River Main with Frankfurt Cathedral on the right*

*A room in Goethe's house. The portrait is that of his mother*

be available here for the convenience of members.

The Exhibition of Petroleum Equipment was one of the successful attractions at the 5th Congress in New York, and there will again be a large Equipment Exhibition in Frankfurt.

## "THE SHOPPING CENTRE OF THE WORLD"

Often called the heart of Germany, with a population of 608,000, the city of Frankfurt is the fifth largest in Western Germany, preceded only by Hamburg, Munich, Cologne, and Essen.

As far back as the Middle Ages Frankfurt was famed as a city of fairs. Called the "shopping centre of the world" and the "mother of all trades", the city achieved this eminence by reason of its extraordinarily favourable location as a centre of trade and culture.

Dürer and Grünewald walked its streets in the Middle Ages, Goethe was born there, Jerg Ratgeb painted the murals in the Carmelite Church. In Kuhhirtenturm on the other side of the Main, Paul Hindemith began his life-work, Max Beckmann painted his pictures, and Ernst May created a new architectural style in housing.

Before the Second World War the city was the starting point for the "autobahn" highways and the home of I. G. Farben, and to-day its airport is the largest in Germany. For hundreds of years—from 1147 until the end of the old Empire in 1792—Frankfurt was the scene of the election of the German emperors, most of whom were also crowned in the cathedral of Frankfurt. The old imperial cathedral, together with most of the Old Town and its many churches, was totally destroyed by bombing in 1944.

The cathedral has now been brought back to its former glories by an outstanding feat of reconstruction, and visitors are now able to view the Electoral Chapel of the Cathedral where in strict seclusion the Electors chose their emperors.

In the aftermath of war the major problem of reconstruction was how to rebuild this Old Town of Frankfurt with its traditions stretching back to the Middle Ages. After much controversy it was resolved by the city council that no part of the Old Town should be reconstructed in its previous form, and in its place a modern residential quarter with broad thoroughfares such as the An der Paulskirche which passes the famous historical St Paul's Church, was carefully planned and built.

The reconstruction work included that of the City Hall, the Römer, which contains the famed 52 portraits of German emperors which look down on the Inperial Hall where for centuries the newly-chosen emperors and the peers of the Empire gathered for the coronation dinner. On the Römerberg Square, which on coronation days became the feasting place of the people, the water in the Justitia Fountain—The Fountain of Justice—splashes to-day the same as in previous centuries. And here one can see the red sandstone pyramid of the Cathedral rising above the modern "Old Town".

Amid the tremendous work that has gone into the post-war rebuilding and economic recovery of Frankfurt, the Rhine-Main metropolis which has changed so much since the 1930's and is slowly engendering a new personality within itself, the old traditions live on. For the town of the imperial coronations, the town of fairs, was also the town of Goethe. The house where the poet was born was completely destroyed in the bombing of 1944. To-day the historic house at Hirschgraben No 23 has been rebuilt as an exact copy of Goethe's former residence, many of the Western Allied powers having contributed towards this project. The furniture of Goethe's mother, Frau Aja, which was in storage outside the city, has been set up again. Goethe's clocks sound the hours and the wallpapers which were described in some of the poet's works were copied by an artist and now adorn the walls of the house.

The city which has risen from the ashes has ten new bridges spanning the Main and is once again an international centre of commerce and trade. The town of the Rothschilds is once more the foremost banking centre in Germany, a centre for insurance business, and still the most important centre in Germany for fairs and congresses.

In 1945 not a single theatre was left standing. Now there are two municipal theatres and three other playhouses. The Grosse Haus, the former Municipal Playhouse, is one of Germany's largest theatres. Visits can be made to the variety of flora and fauna at the Palmengarten (the Botanical Gardens) and the Zoo. In the sphere of the arts there is the Städelsche containing a collection of paintings by both old masters and the modern schools, and the Skilled Handicrafts Museum with specimens of work belonging to various ages and styles. The many museums also include the Historical Museum, the new Federal Postal Museum (a must for philatelists one would imagine) and the Senckenberg Museum of Natural History which is particularly famed for its ancient fossils.

The shopping centres are luxurious and smart, there is a golf course close at hand, and roulette or baccarat can be played, it is reported, just outside the city boundary at Bad Homburg. The traditional "wine" of Sachsenhausen just across the Main is cider, whose destructive properties are beautifully conveyed in the words of the Official Guide by "the more one drinks the easier it is to understand the local dialect". Linguists please note.

The new Frankfurt which has grown out of the ravages of war to regain its former eminence should prove to be a fitting spot for the Sixth World Petroleum Congress.

## THE CADMAN MEMORIAL MEDAL AND LECTURE

The Sixth Cadman Memorial Lecture will be delivered by Sir Stephen Gibson, C.B.E., on 31 October 1961, in the hall of the Royal Institution, London. The Medal will be presented to him by the President, and the subject of the lecture will be announced next month.

The lecture will commence at 4 p.m. and tea will be provided after its conclusion.

# Norway's First Major Oil Refinery

## *Opening of Esso's Plant at Slagen*

Situated amid the impressive surroundings of Oslo Fjord, the Slagen refinery—the largest in Scandinavia—was dedicated on 8 July last by H.E. the Norwegian Prime Minister, Einar Gerhardsen. Norway's first major refinery, the 40,000 bd plant is about 70 miles south of Oslo and cost a total equivalent of £11 million.

It was built by A/S Esso Raffineriet Norge, a wholly-owned affiliate of Standard Oil Co. (New Jersey), in 20 months, in spite of the difficulties of winter working in Norway, coming into operation at the end of 1960.

In addition to being the largest refinery in Scandinavia, Slagen is said by Jersey Standard to be the most modern in the world, and the terminal is the only dock in Scandinavia which can accommodate an 100,000-ton tanker. The refinery is close to the major Scandinavian markets and also offers a well-protected ice-free harbour with the necessary deep water for optimum economy in the handling of oil cargoes.

**The Site**

The site was purchased in July 1959, when clearing and grading were initiated. Contractors began work in February 1960 and construction was completed in November of the same year.

Every effort has been made to conceal the refinery so as to detract as little as possible from the beautifully wooded coast which surrounds it. The site has been terraced on the slopes of the ridge which forms the western property line and which reaches a maximum point of 165 ft above sea level. By this means refinery plant, which are also painted in neutral colours to blend with the surroundings, have been landscaped into the slopes in a manner similar to that used successfully at the Esso refinery at Milford Haven. This was first planned out on a specially-constructed scale model of the site.

The refinery occupies 124 acres of a total company property area of 580 acres, leaving room for considerable expansion.

**Process Units**

Scandinavia's oil demand having a heavy preponderance of middle distillates dictated that the design of the Slagen refinery should emphasize the production of this range of products, lesser importance being given to the output of gasoline. Thus, a refinery of the hydroskimming type was planned rather than a fluid catalytic cracking type. The four process units were designed to handle greatly varying types of crude oil, from Venezuelan naphthenic crudes to the waxy high-sulphur crudes of the Middle East.

The crude oil atmospheric distillation unit is designed to process 40,000 bd. The furnace has a heat release of about 150 million Btu/hr from 20 burners mounted in a single row.

Two streams in parallel, for processing light and heavy virgin naphtha respectively, are treated in the copper chloride unit. The light naphtha stream has a capacity of about 2000 bd from the light ends section, and the heavy naphtha stream has a capacity of about 7800 bd from the pipestill.

The 4200 bsd Hydrofiner depends on the pipestill for its feed and the Powerformer for its treat gas. However, a

Hydrofiner shut-down does not affect the operation of the other two units.

The catalytic reformer is based on the Esso Model II semi-regenerative Powerformer and is designed to reform 7200 bsd of light and heavy naphtha blends. The operation whereby Powerformer and the Hydrofiner receive feed from the pipestill reduces the need for intermediate storage and the reheating and pumping of other streams.

Two grades of gasoline are produced by an in-line blending system. The continuous leading system, employing the weigh tank method of control, was supplied as a package unit by The Associated Octel Co. Ltd.

*The control room for the refinery units*

Slagen is the first of two refineries to be completely equipped with airfin coolers which eliminate the need for an otherwise expensive and potentially troublesome cooling water system. Electronic units are used throughout the process control, and all process units and the steam plant are designed to operate as a single unit from a common control room.

A short ground flare of the multi-jet type designed to burn 5 million cu ft/day with a smokeless and non-luminous flame takes the place of the conventional tall flarestack.

**Storage Facilities**

Crude for 23 days' operational supply is provided for by five floating roof tanks with a capacity of 1 million brl. Each tank is 54 ft high, has a diameter of 160 ft, and is fitted with three 25 hp side-entry mixers to ensure uniform feed to the crude unit. In all there are 60 tanks and 6 spheres for LPG. The total storage capacity is 12·3 million brl.

The contract for the refinery tankage was awarded to an American firm, the Graver Tank & Manufacturing Company, on the basis of competitive bids solicited from over half-a-dozen countries. Tank plate, all of which originated in Japan, was delivered to Norway in one shipment. Fabrication and erection was done under Graver's supervision using the personnel and shop facilities of Marinens Hovedverft, a Norwegian firm that operates a nearby shipyard.

Tanks are located to minimize the length of interconnecting piping runs within the limits of orderly layout and the landscaping requirements. The refinery has a total of over 130 miles of pipe, in diameters ranging from 0·5 in to 26 in. Most are of seamless carbon steel to API:5L or ASTM: A106.

The previously-mentioned scale model of the site helped to determine the natural drainage routes over the sloping land. Thus each row of tanks is separated by a diversion wall which directs any flow to open ditches emptying into a central impounding basin and oil-skimming pond located near the shore. The system is designed to handle storm water as well, and obviates the need for a conventional, more costly, fire wall system.

Ballast tanks receive ballast water from incoming tankers and barges which is treated to remove and recover all oil before returning water to the fjord.

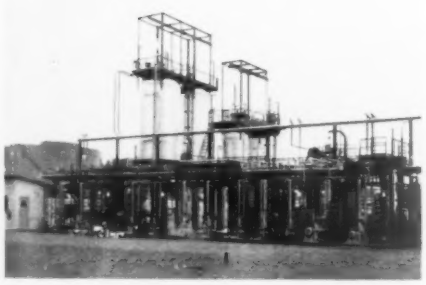
**Marine Terminal**

Essentially all products will be transported from the refinery in barges and tankers. A single pier with three berths is provided. One berth can receive tankers of up to 100,000 tons. The other two berths accommodate barge traffic, while one also receives coastal tankers up to 19,000 dw tons.

The pier is 1800-ft long, reaching out to a depth of 54-ft and resting on 500 concrete piles forced into the sea-bed.

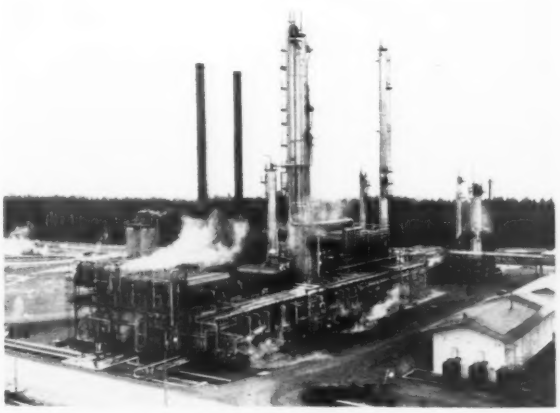
Crude oil is received from tankers at a rate of 40,000 brl/hr and product loading can be achieved at 24,000 brl/hr. Over 600 vessels are expected to call each year.

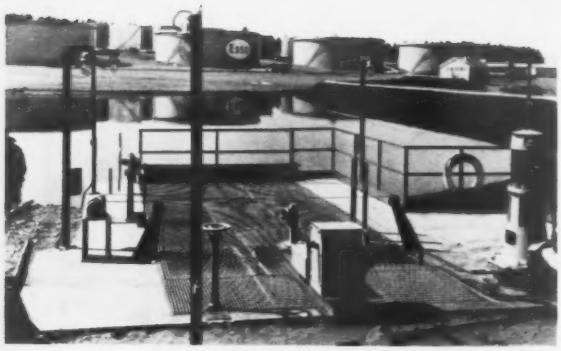
The detailed engineering and construction of the marine terminal was awarded to the Royal Netherlands Harbour Works. The detailed engineering was done in Amsterdam. Dutch supervision and Norwegian labour carried out the construction.



*The copper chloride unit*

*The refinery pipestill*





*The skimming pond with the tank farm in the background*

*The refinery's LPG storage facilities*

**Administration and Service Facilities**

The administration building houses the management and staff functions, including accounting, employee relations, medical, public relations, technical transportation, and supplies offices.

In the general service building are housed the laboratory, mechanical shops, and warehouse.

The refinery utilizes 25 million kW hours of electricity annually, the power being obtained by two separate feeder systems from the national grid.

**Pollution and Noise Control**

It is of interest that Norway has the supreme example of a Good Neighbour Act to protect individuals from noise, pollution, property encroachment, and other potential disturbances created by their neighbours. Strict adherence to such principles has been an important consideration in the design and layout of the refinery. In addition to such measures already mentioned, the use of equipment that would produce a high level of noise has been avoided, and furnace noise is reduced by the use of burner mufflers. All tanks, lines, and lowers are painted in soft pastel colours to harmonize with the natural background.

**Construction**

The efforts associated with designing and building the refinery represent a truly international undertaking. The basic design of the refinery was done by the Esso Research and Engineering Company, which, as Esso-Raffineriet's engineers, also had the responsibility of supervising the contractors. European Bechtel Corp was awarded the detailed engineering and construction of a major portion of the refinery. This was carried out in Rome under Bechtel's supervision by Compagnia Tecnica Industrie Petroli. Bechtel's construction responsibility was carried out through a Norwegian company, A S Bechtel-Sverdrup, Norge. Major buildings, site preparation, and other services were provided independently by 16 Norwegian contractors and sub-contractors.

Purchasing during construction was on an international basis, competitive bids being obtained on the world market. Materials and equipment were obtained from 11 different countries, Norway, Italy, and the United Kingdom heading the list of supply sources. Of the total cost of £11 million, nearly 60 per cent was spent in Norway for labour, material, and services.

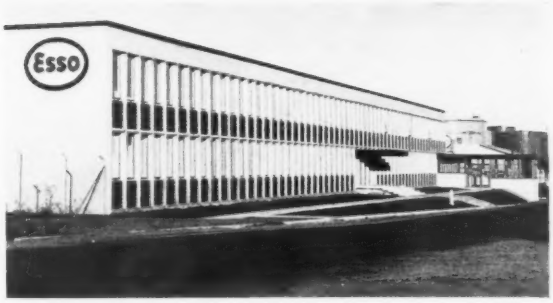
*The 1800 ft-long pier which can accommodate tankers of 100,000 dw tons*

### THE MARKET

The Norwegian economy, which is largely dependent on international trade, has been going through a period of steady growth over the last decade, registering an increase of 45 per cent in the gross national product and 65 per cent in industrial production during that period.

Oil consumption in Norway has doubled over the last ten years to a point where it now supplies 42 per cent of the country's total energy requirements. Annual demand by 1965 is estimated to be 4·5 million tons, and Esso's Slagen refinery will be able to supply 2 million tons of that requirement.

The refinery is now supplying Esso marketing companies in Norway, Denmark, and Sweden.




*The administration building—the nerve centre of the refinery*

★ ★ ★

# The President's Room

For some little time the Council have felt that when distinguished visitors attend meetings or other functions at the Institute it would be very pleasant if the President had a room of his own where he could entertain them and which he could also use as his office when he required it.

It was, therefore, decided to convert the lobby on the first floor, that had previously been used as an overflow room for the library, into a room for the President's use.

This lobby is a circular room, with a painted ceiling, an Adam fireplace and two wooden dados round the walls that over the centuries had become so encrusted with paint that only the merest semblance of a pattern showed through.

Messrs Roffé Ltd, who had previously restored all the old ceilings in the building, undertook the paintwork and discovered under the dark green paint three mural paintings on the three "Lunettes", high up on the walls. It seems extraordinary that someone, during the last two hundred years, should have deliberately painted over these beautiful paintings, but they are now wonderfully restored and blend into the magnificent ceiling painting already there.

The carved wooden dados have also been restored to their former glory, and Roffe's estimated that something like fifty coats of paint had to be removed before they got down to the actual woodwork!

Granthams (Leatherhead) Ltd, who furnished most of the rest of the building, have again done the furnishing and this former lobby is now a most charming room furnished and decorated in the style of the Georgian period.

# Notes of the Month

### Getty Oil Group's U.K. Marketing Plans

The announcement that Veedol motor oils were to be available henceforth to the British motorist was made on 11 July by the managing director of Veedol (U.K.) Ltd, G. G. E. Money. For many years the Tidewater Group has been marketing bulk supplies of lubricating oil base stocks in Britain under Tidewater Oil Co. (England) Ltd (formerly Clarendon Petroleum Co. Ltd). The movement of J. Paul Getty's Tidewater organization into retail marketing of lubricating oils in Britain is another step in the increasing number of foreign oil companies to show an active interest in retail petroleum markets in the U.K. Over the last eight months Cie Française des Pétroles and Continental Oil have joined the market and rumours still persist that Signor Mattei's AGIP and others are contemplating like moves.

*J. Paul Getty*

Veedol (U.K.) Ltd has taken over Tidewater Oil Co. (England) and will market five grades of lubricating oil already being sold in more than 80 other countries.

Distribution had already begun in London and the Home Counties, and full national distribution is expected in twelve months time. A gift voucher scheme for free sump refills will be offered to many motorists to give them an opportunity of testing Veedol oils for themselves.

The English company has expressed its intention of supporting motor and motor cycle racing, initially at the national and club level.

Blending and packaging is carried out at the Company's depot at Birkenhead, Cheshire, and all additives used in blending will be of British manufacture.

Supplies will initially come from the Tidewater refinery at Wilmington, Delaware. Built in 1956, with a capacity of 130,000 bd, this was the largest "grass roots" refinery ever built. Its units include a 102,000 bd catalytic cracker. These would be supplemented by products from the Group's Gaeta refinery in Italy.

The oils will be marketed in cans for ease of stocktaking and display, and will be contained in special can racks. Each oil has a single SAE grading—no change will be required according to the change in season, which also eases stock control.

In addition to a promise of lower prices "shortly", Mr. Money said that no refinery was planned by his Company in Britain at the moment. The Tidewater refinery at Kalundborg in Denmark, which was coming into operation shortly would have no lubricating oil facilities in the early stages and would thus not be supplying the Birkenhead plant under present conditions.

He did not discount the possibility of the Tidewater Group entering into the retail motor spirit market in the U.K. in the future.

### Drilling Progress in Iran

The National Iranian Oil Company is drilling in a new northern location at Yort-e-shah, which is some 95 km south east of Teheran and over 60 km from Sarajeh. At the time of writing the well had reached a depth of 240 ft.

Other news of NIOC oil search operations was that Alborz 9 was drilling at 6570 ft and that Sarajeh Nos 5 and 6 were being cemented at 8992 ft and 8757 ft respectively.

IPAC had spudded-in both its new offshore wells D-1 and C-1, which had reached depths of 2520 ft and 260 ft and were being reamed.

SIRIP was reported to be testing its offshore well No 2 at 7929 ft and to be drilling at 9898 ft at Sequtah on the Zagros Agreement Area.

### Australian Offshore Search Intensified

More interest than ever before is being shown in survey activity to evaluate the oil exploration possibilities of Australia's offshore seabeds.

The first official underwater geological party in the Commonwealth recently tested sedimentary deposits at depths of 20 to 40 ft in St Vincent Gulf, South Australia, in an area held under permit by Geosurveys of Australia Ltd. Initial tests suggested that oil bearing strata could lie below the Gulf.

Broken Hill Pty Co. Ltd has made a preliminary aerial magnetometer reconnaissance of its Bass Strait permit area and is reported to be considering a full scale aerial survey. Future activity in South Australian waters is expected in the area between Kangaroo Island and the Victorian border, and a licence for deepwater drilling in this area has been issued to Australian Pacific Co. Pty Ltd. Camelot Nominees Pty Ltd is to invest £250,000 in an under-water survey of 9600 square miles in the Gulf of Papua.

An offshore seismic survey along Victoria's Western District coastline earlier this year helped Frome-Broken Hill to choose the site for its fourth well currently being drilled between Port Campbell and Warrnambool. In Western Australia, WAPET may explore offshore in an effort to solve the riddle of oil found in 1953 at Exmouth Gulf where, after the initial flow of oil, many land-based attempts to find the reservoir failed.

The entire Northern Territory coast, almost all the Queensland coast, and Port Philip Bay, Victoria, have been included in marine gravity surveys by the Bureau of Mineral Resources in the last four years. But despite this activity some Australian authorities consider that it may be several years yet before under-water drilling is in progress.

### Building of New Zealand Refinery Starts Soon

Construction of the £14 million refinery at Marsden Point, Whangarei, New Zealand may begin by the end of this year and should come on stream early in 1964. When completed the refinery is expected to supply about 90 per cent of New Zealand's annual requirement of petroleum products.

The shareholding of the refining company will include the general public and the oil companies distributing petroleum products in New Zealand, among them BP, which will take up a 15 per cent share of the equity.

At the refinery site at Marsden Point, there is a considerable area of flat land, with a deep safe anchorage in the harbour nearby suitable for use by tankers of at least 65,000 dw tons. Power and water supplies are available locally.

The main processing plants in the refinery will include a crude distillation unit; a catalytic reformer; a gasoline treatment unit; a bitumen plant; and possibly a gas oil hydrodesulphurizer. The initial throughput will be about 2½ million tons/year, and motor spirit, gas oil, diesel oil, fuel oil, and bitumen will be produced.

### Milestone for U.S. Refinery

Tidewater Oil Co.'s Delaware refinery processed its 200 millionth barrel of crude recently, less than 5 years after it began operations.

The refinery's 150,000 bd crude unit, believed to be the world's largest, went on stream in September 1956. During its first 58 months it was operating for 1722 days out of 1765 possible days for a service factor of 97·5 per cent.

The crude unit established a world's record towards the end of December 1960 by processing at the rate of 159,000 bd of crude.

### New Unit at Montreal Refinery

The newest installation at the British American Oil Co. Ltd refinery at Montreal is a 7000 bsd *Udex* unit which has just started up.

The new plant takes its aromatics-rich feedstock from the refinery's catalytic reforming installation. The benzene which it produces is then used in cumene production with $C_7/C_8$ aromatics blended into premium motor fuel, while raffinate from the unit is used as required in JP4 jet fuel.

### Extensions at Vinyl Acetate Plant

The growing world demand for vinyl acetate monomer has caused Hedon Chemicals to make big extensions to their vinyl acetate plant at Salt End, near Hull, which will increase productive capacity there by some 60 per cent.

Hedon Chemicals is jointly owned by The Distillers Co. and Shawingan Chemicals of Canada, and these extensions have been made only five years after the original plant was commissioned.

Vinyl acetate is used in the manufacture of emulsion paints and adhesives. Copolymers with vinyl chloride are used for plastic compositions such as floor tiles and gramophone records, and solution lacquers. Vinyl acetate finds application in the production of cements and elastomers, and is also the raw material for polyvinyl alcohol.

### Change of Name for Esso Company

The name of the Esso Export Corporation has been changed to Esso International Inc.

It is understood that the change of name does not indicate any chage of activities but has been made solely to reflect the international character of its operations.

### Minister Considering Proposals for Saharan Gas Imports

Details of the Agreement reached by the Gas Council, Conch International Methane Ltd, and the French authorities under which liquid methane would be supplied from the Hassi R'Mel gas field in the Sahara to Great Britain are now being studied by the Minister of Power.

The scheme provides for the importation of approximately 350 million therms (some 700,000 tons) of liquid methane per annum from Port Arzew, near Oran, to Canvey Island.

If the proposals are approved by the Minister, orders would be placed with British shipyards for two ships, each with a capacity of 11,000 tons of liquid methane, to transport the gas.

### ICI Plans for Rotterdam Site

Construction is to start soon of the first plants on the 300-acre site which ICI is leasing in Rotterdam to give the Group its first production facilities in the EEC.

The plants will produce ICI's brands of acrylic sheet and acrylic moulding powder, and methyl methacrylate from which they are made. This first stage of the Group's plans for a £100 million works at Rotterdam is expected to cost some £7 million.

The units are scheduled to start up towards the end of 1963. Until they are ready, U.K. exports of the products concerned will be increased in an attempt to enlarge the market in Europe ready to absorb the products of the new works, which are to be known as the Rozenburg Works.

*The* Esso Pembrokeshire, *which was launched at Bremen recently and is the first of five new "County Class" 77,000-dw ton tankers on order for Esso Petroleum Co. Ltd, will have the largest displacement of any ship built in Europe, and is expected to be in service between the Middle East and the Milford Haven or Fawley refineries before the end of the year. The hull throughout the cargo tank length is divided both longitudinally and transversely into 39 separate compartments, four of which are utilized for permanent water ballast only. The vessel is of all-welded construction, with the exception of certain riveted longitudinal seams for stress relieving*

# Personal Notes

*A. V. Billinghame*

*P. J. March*

**A. V. Billinghame** and **P. J. March** were appointed directors of Shell Chemical Co. recently. Mr Billinghame joined Shell in 1942 and was closely associated with Shell's entry to the chemical business in the United Kingdom at that time, and its subsequent development. During the post-war years he was concerned particularly with the development of export markets. He will continue to hold the position of regional co-ordinator III (U.K., Central and South America) with Shell International Chemical Company.

Mr March joined Shell in 1949, and, after a period with the former Chemical Industry Administration of Shell Petroleum, transferred to Shell Chemical Company on his appointment as manager of Egham Technical Service Laboratories in 1955. Two years later he moved to head office as marketing manager, industrial chemicals. Last year he was appointed general manager of the newly formed Industrial Chemicals Division, a position he will continue to hold.

**Eric G. Lindroth,** a director and senior vice-president of the former Esso Export Corporation, has been appointed European financial representative for the treasurer's department of Standard Oil Co. (New Jersey). He succeeds **L. B. Johnson** who recently joined the board of Esso Petroleum Co. Ltd. During the 25 years he has been with Jersey Standard, Mr Lindroth has held various financial positions including assignments with the Group's Venezuelan affiliate.

**George T. Piercy** has been appointed executive assistant to **M. J. Rathbone,** president and chief executive officer of Standard Oil Company (New Jersey). Mr Piercy, who has been manager of the Company's co-ordination and petroleum economics department since the middle of 1960, succeeds **Chadwick H. Carpenter,** who has been elected a director of Esso Mediterranean, Inc.

A chemical engineering graduate of the University of Minnesota, Mr Piercy began his oil industry career at the Baton Rouge refinery where he later became assistant manager of the crude and marketing division. In 1951 he joined the Esso company in New York as assistant co-ordinator of refining. He became head of that department in 1953, and in 1955 was named general manager of the supply department.

**Harold W. Stoneman** has been appointed manager of the Producing Department of Esso Petroleum Co. Ltd which is to undertake the exploration for gas and oil in specified areas in South-east England. Mr Stoneman has been with the Esso Group for 24 years, and has had wide exploration and producing experience in several countries. For the last 3 years he has been director and general manager of Esso Exploration Guine Inc. in West Africa.

**W. F. Mitchell,** B.Sc., F. Inst. Pet., will become executive vice-president of Shell Oil of Canada at the beginning of January 1962. He will be succeeded as director of co-ordination – chemical, with Shell International Chemical Co. in London, by **Willem Starrenburg,** who is a member of the board of Shell International Petroleum Co. Ltd.

Mr Starrenburg joined the Royal Dutch/Shell Group in 1932 after graduating as a mining engineer at the Technological University, Delft. His subsequent service has included appointments in the field as a trainee in Rumania and Indonesia, and also in Venezuela, where he became chief production engineer in 1942 and served as manager, Western Division from 1950 to 1956. He has also held appointments in the U.S.A. and worked in London during World War II. In May 1956, he became head of the Production Division in Group central offices in The Hague, and a year later, co-ordinator – exploration and production. In July 1960 he was appointed regional co-ordinator – oil for the Caribbean, Central and South America.

*W. F. Mitchell*

*Willem Starrenburg*

Mr Mitchell was appointed director of co-ordination – chemical in 1959 and in the same year he was appointed to the Board of Shell International Chemical Co. and Bataafse Internationale Chemie Maatschappij, N.V. He is a science graduate of Queen's University, Kingston, Ontario, and spent an early part of his career with the Engineering Department of Shell Oil Co. of Canada Ltd in Toronto. He then formed the Technical Products Department of that company and became successively operations manager and general sales manager. In 1947, he took up a senior position with Shell's newly formed Industrial Development Management in London. Three years later he formed what was later known as Chemical Industry Administration and was appointed its first general manager with responsibility for co-ordinating all Shell commercial activities outside the United States and Canada.

**J. F. Widman,** director and general manager of Union Carbide Ltd, is retiring from the Company's board to take up a new appointment with the Union Carbide International Company. **K. D. Rutter** has become marketing manager of Union Carbide's Chemicals Division.

*A. H. King*

*G. N. Peters*

**A. H. King,** divisional manager of Shell-Mex and B.P. Ltd's Southern Division, has retired and has been succeeded by **G. N. Peters.** When he retired, Mr King had completed 47 years with the Group, thirty-six of them in managerial positions.

Mr Peters' previous post was sales manager (retail), of the Company's Southern Division.

We record with regret the recent death after a long illness of **John Tedd,** export sales manager of The Distillers Co. Ltd. Mr Tedd was a B.Sc. of Belgrade University and he qualified as a mining engineer at the Camborne School of Mines. He had been with the Company since 1957.

**J. F. D. Wood,** A.M.I.C.E., has been appointed sales director of Sanders and Forster Ltd. He joined the Company in 1954 as erection manager and was appointed home sales manager in 1957. In 1958, he became sales manager and was made general sales manager earlier this year.

★ ★ ★

## COST OF NEW OIL DUTY TO USERS

The effect of the 10 per cent increase in duty on hydrocarbon oils announced by the Chancellor of the Exchequer recently, will bear especially heavily on motor fuels, the tax on which was increased by 3*d* a gallon. This tax was already contributing over £400 million a year to the Exchequer before the increase, three-quarters of which came from business and commercial consumption, and the new increase, which will raise the duty to 2*s* 9*d* a gallon on motor spirit and Derv will cost another £40 million in a full year. In addition, heavy oils, other than those used in road transport, are now paying 10 per cent over and above the duty of 2*d* per gallon imposed in the April Budget. This will cost users, mainly industry, £5 million extra in a full year.

The estimated cost of this additional burden on hydrocarbon oils to individual users is shown in the following tables, which were released by the Petroleum Information Bureau recently.

TABLE I

GAS, DIESEL, AND FUEL OILS

(Cost of 10 per cent Increase)

| | £ |
|---|---|
| *Burning* | |
| Central Heating | 639,310 |
| Bakeries | 28,530 |
| Glass | 85,410 |
| Ceramics | 46,190 |
| Steel Manufacture | 471,950 |
| Industrial Furnaces | 174,360 |
| Agricultural Driers and Heaters | 18,220 |
| Steam Raising | 1,866,730 |
| *Power* | |
| Agricultural Power Units | 124,130 |
| Rail Traction | 62,120 |
| Stationery Oil Engines | 106,300 |
| Mobile Diesel Engines | 93,000 |
| *Manufacture* | |
| Gas Making | 84,220 |
| Other Manufacturing | 118,600 |
| Petroleum Industry's Own Use | 39,780 |
| TOTAL | 3,958,850 |
| *Burning Oils* | |
| Farming | 3,550 |
| Industrial and Railways | 11,830 |
| Services and Other Government | 6,390 |
| Domestic Heating, Lighting, and Cooking | 284,710 |
| TOTAL | 306,480 |
| *Vaporizing Oil* | |
| Agricultural Tractors and Stationery Engines | 62,330 |
| Industrial | 3,200 |
| TOTAL | 65,530 |
| *Lubes and Greases* | |
| Aviation | 2,070 |
| Industrial | 107,900 |
| Marine | 15,150 |
| Motor | 67,440 |
| Tractors | 7,680 |
| TOTAL | 200,240 |

TABLE II

MOTOR SPIRIT AND DERV FUEL

(Cost of 10 per cent Increase)

| | *Motor Spirit* | *Derv* | *Total* |
|---|---|---|---|
| | £ | £ | £ |
| Cars and Motor Cycles | 18,065,470 | — | 18,065,470 |
| Taxis | 99,450 | — | 99,450 |
| Public Services | 313,650 | 2,803,500 | 3,117,150 |
| Goods Vehicles | 7,841,250 | 5,617,010 | 13,458,260 |
| Industrial Use | 822,370 | — | 822,370 |
| Agricultural Use | 841,500 | — | 841,500 |
| Services and Other Government | 1,032,750 | — | 1,032,750 |
| Petroleum Industry's Own Use | 65,020 | 120,150 | 185,170 |
| Miscellaneous | 84,150 | 76,760 | 160,910 |
| TOTAL | 29,165,610 | 8,617,420 | 37,783,030 |

TABLE III

TOTAL DUTY PAYABLE PER ANNUM

(Including that payable prior to latest increase)

| | £ |
|---|---|
| Gas, Diesel, and Fuel Oils | 43,547,819 |
| Burning Oil | 3,371,313 |
| Lubricating Oil and Greases | 2,202,615 |
| Vaporizing Oil | 720,743 |
| Motor Spirit | 320,821,860 |
| Derv | 94,791,670 |
| TOTAL | £465,456,020 |

The above figures are based on oil consumption in 1960. In his Budget last April the Chancellor anticipated a substantially higher revenue from duties on oil products. If this estimate is realized the overall cost of oil duties during the present financial year will be well over £500 million.

# U.K. OIL IMPORTS 9 PER CENT HIGHER IN FIRST HALF YEAR

During the first 6 months of 1961, U.K. oil imports rose by some 693,236,000 gal or 9·3 per cent, to 8,187,686,000 gal.

Of this total, crude oil imports of 6,635,784,000 gal were 1,016,917,000 gal higher, accounting for 81 per cent of all petroleum imports compared with 75 per cent the previous year. Although total imports of refined products dropped by 323,681,000 gal, imports of motor spirit and lubricating oil recorded modest increases of 5 per cent and 9 per cent respectively.

Some small changes in the pattern of supply were noticeable. While the proportion of imports from the Middle East rose slightly, those from the Caribbean area were lower both in volume and proportion than in the same period of 1960. The growth in output in Nigeria was reflected in a rise in imports from that country of 67,306,000 gal, which helped to raise its share of oil entering the U.K. to 2 per cent of the total.

IMPORTS OF PETROLEUM INTO THE UNITED KINGDOM
(Thousand gallons)

| | January to June 1961 | | | | | | | January to June 1960 | |
|---|---|---|---|---|---|---|---|---|---|
| | *Crude petroleum* | *Motor spirit* | *Kerosine* | *Gas, diesel, and fuel oils* | *Lubricating oil* | *Total* | *Percentage of total* | *Total* | *Percentage of total* |
| MIDDLE EAST | | | | | | | | | |
| Kuwait | 3,058,206 | — | — | 16,574 | — | 3,074,780 | 37·5 | 2,726,864 | 36·4 |
| Iraq | 876,577 | — | — | — | — | 876,577 | 10·7 | 804,781 | 10·7 |
| Iran | 815,472 | 4,436 | — | 13,196 | — | 833,104 | 10·2 | 719,824 | 9·6 |
| Saudi Arabia | 351,539 | — | — | 87 | — | 351,626 | 4·3 | 239,387 | 3·3 |
| Bahrain, Qatar, and Trucial States | 129,726 | 55,133 | 16,627 | 83,783 | — | 285,269 | 3·5 | 282,170 | 3·8 |
| Aden | — | 1,291 | 5,275 | 17,530 | — | 24,096 | 0·3 | 54,713 | 0·8 |
| | 5,231,520 | 60,860 | 21,902 | 131,170 | — | 5,445,452 | 66·5 | 4,827,739 | 64·6 |
| CARIBBEAN AND SOUTH AMERICA | | | | | | | | | |
| Venezuela | 803,985 | 17,182 | 5,669 | 266,889 | 6,614 | 1,100,339 | 13·4 | 1,112,387 | 14·8 |
| Netherlands Antilles | 67,217 | 79,191 | 16,791 | 92,428 | 20,586 | 276,213 | 3·4 | 262,120 | 3·5 |
| Colombia | 82,501 | — | — | — | — | 82,501 | 1·0 | 136,749 | 1·8 |
| Peru | 26,194 | — | — | — | — | 26,194 | 0·3 | 19,199 | 0·3 |
| Trinidad | 84,651 | 78,116 | 16,357 | 167,392 | — | 346,516 | 4·3 | 385,653 | 5·1 |
| | 1,064,548 | 174,489 | 38,817 | 526,709 | 27,200 | 1,831,763 | 22·4 | 1,916,108 | 25·5 |
| UNITED STATES | 5,982 | 12,656 | 1,739 | 692 | 28,808 | 49,877 | 0·6 | 61,514 | 0·8 |
| EUROPE | | | | | | | | | |
| Netherlands | 56,006 | 70,148 | 18,489 | 93,060 | 8,792 | 246,495 | 3·0 | 346,206 | 4·6 |
| France | — | 38,571 | — | 93,700 | 2,803 | 135,074 | 1·6 | 31,688 | 0·4 |
| Italy | — | 21,221 | — | 37,707 | — | 58,928 | 0·7 | 42,116 | 0·6 |
| West Germany | — | — | — | 9,773 | — | 9,773 | 0·1 | 5,417 | 0·1 |
| Soviet Union | — | — | — | — | 3,934 | 3,934 | 0·1 | 6,016 | 0·1 |
| | 56,006 | 129,940 | 18,489 | 234,240 | 15,529 | 454,204 | 5·5 | 431,443 | 5·8 |
| FAR EAST | | | | | | | | | |
| Sarawak | 19,871 | — | — | — | — | 19,871 | 0·2 | 17,788 | 0·2 |
| AFRICA | | | | | | | | | |
| Nigeria | 159,835 | — | — | — | — | 159,835 | 2·0 | 92,529 | 1·2 |
| OTHER COUNTRIES | | | | | | | | | |
| British Commonwealth | 26,212 | 2,045 | 813 | 57,062 | 549 | 86,681 | 1·1 | 77,102 | 1·0 |
| Foreign | 71,810 | 46,314 | 2,653 | 16,162 | 3,064 | 140,003 | 1·7 | 70,227 | 0·9 |
| | 98,022 | 48,359 | 3,466 | 73,224 | 3,613 | 226,684 | 2·8 | 147,329 | 1·9 |
| GRAND TOTAL | 6,635,784a | 426,304 | 84,413 | 966,035b | 75,150 | 8,187,686 | 100·0 | 7,494,450 | 100·0 |
| PERCENTAGE OF TOTAL | 81·1 | 5·2 | 1·0 | 11·8 | 0·9 | 100·0 | — | — | — |
| GRAND TOTAL Jan.-June 1960 | 5,618,867 | 404,919 | 101,956 | 1,299,513c | 69,195 | 7,494,450 | — | — | — |
| Percentage of total | 75·0 | 5·4 | 1·4 | 17·3 | 0·9 | 100·0 | — | — | — |

(a) Of this total 399,945 gal was refinery feed.
(b) Made up of gas oil, 305,742 gal; diesel oil, 13,335 gal; and fuel oil, 646,958 gal.
(c) Made up of gas oil, 317,689 gal; diesel oil, 11,942 gal; and fuel oil, 969,882 gal.

*This panoramic view of modern shale oil operations is of Scottish Oil's Westwood Works, showing from right to left, Westwood Pit, shale delivery to crushers, water cooling tower, main shale conveyor, sulphate of ammonia house, retorts, scrubbing towers, crude oil storage tanks, spent shale bings, exhauster house, naphtha recovery plant, naphtha storage tank, and ammonia water storage tank on extreme left*

**Branch of the Month**—The Scottish Branch Contributes

# . . . Of Candles and Lamps and Moby Dick and "Paraffin" Young

Our forefathers of 150 to 200 years ago probably derived more than one advantage from complying with the saying "Early to bed and early to rise makes a man healthy, wealthy, and wise". They got a night's sound sleep, for it is said that one hour's sleep before midnight is worth two after; no doubt, they caught "the early worm" next morning; moreover, if they went to bed early, there was little need during a large part of the year to burn artificial light. If they were poor, they burnt hardly any anyway; the firelight had to suffice on a winter's evening; if they were looking for something in the dark, they used a rushlight. Those who were better off, like Jane Austen's heroines or the ladies of Cranford, had candles, which, however, were used sparingly, especially if they were made of beeswax rather than tallow. They certainly were not of paraffin wax, for Lyon Playfair—later Lord Lyon Playfair of St Andrews, a friend of "Paraffin" Young, president of the Chemical Society and professor of chemistry at Edinburgh University, stated in his memoirs that he could not remember seeing a piece of paraffin of more than one ounce in weight until after 1850.

Candles are said to have been invented around 1200. Before that time lamps were used in which oil of either vegetable or animal origin was burnt, but as wicks were unknown they cannot have shed much light. In addition, they must have been smelly, which perhaps accounted for the preference for fragrant oils among the rich people in antiquity. The lamps used in the Middle Ages and even as late as the 18th century were almost as primitive. The fuel in Southern Europe was olive oil and in Northern Europe colza oil, *i.e.* rapeseed oil, and, from the 16th century onward, whale oil—also called train oil from the German word *tran*. A dim, smoky light is still called *tranfunzel* in German, an indication of the amount of light these whale oil lamps gave. No wonder people preferred candles.

Tallow candles were the most common in the 18th century, but candles from spermaceti—a product of the whale which readers of Moby Dick will be familiar with—were also used. It may be recalled here that according to the (London) Metropolis Gas Act, 1860, the unit of a candlepower is defined as the amount of light given by a pure spermaceti candle weighing $\frac{1}{6}$ lb and burning at the rate of 120 grains/hour.

In 1823 Chevreul discovered how to remove the glycerins from tallow and so obtained stearine. These candles gave a much better light and burnt without spluttering. Price's invented the snuffless candle in 1840 by twisting the wick, and de Milly improved the quality of stearine in 1855 by lime-purification. In 1859 "Paraffin" Young's paraffin wax appeared on the market. Candlemakers at first preferred it for its brighter light, but as its softening point was below that of stearine, paraffin candles tended to lose shape in a warm room. So a mixture of fats and waxes was chosen. By that time, however, the candle had been relegated to the bedroom, for the inventors of lamps had not been idle.

A great stride forward in lamp design was made in 1784 when Ami Argand, a Swiss domiciled in England, invented

a lamp which had a wick, a glass chimney which rested on a perforated ledge, and an oil reservoir which was mounted separately from the burner a little higher on a stand. The wick was cylindrical and was fitted between two metal tubes, one within the other. Oil flowed up between the tubes and a current of air circulated around as well as inside the wick. The light from Argand's lamp was so startling to eyes accustomed to the old oil-lamps and candles—especially after Jean Quinquet, a Frenchman, had added a reflector—that "it was too dazzling for the sight to bear". The brothers Girard further improved Argand's lamp by placing the oil reservoir below the burning wick. Their lamp had its debut in London in 1807 at a party given by the Duchesse de Berry. "It was enthusiastically admired, so much so indeed, that the Empress Josephine, the wife of Napoleon, ordered the Brothers Girard to attend at the Tuileries and bring a lamp with them". The final improvement came in 1836 with Franchot's "Moderator" lamp, in which a spring acted on a piston in the oil reservoir and caused the oil to pass up a tube to the wick in the burner. The tube contained a movable rod which "moderated" the flow of oil. This lamp was still so widely used in the 1860's that a writer could state in 1869: "Everyone of us is acquainted with it, and it may almost be looked upon as perfection in the matter of oil lighting." It was not only the lamp that was being improved: the fuel too was getting better. In 1790, almost simultaneously in England and France, the refining of lamp oil, *i.e.* colza and whale oil, by means of sulphuric acid was discovered.

**Importance of Whale Oil**

It would seem that up to the end of the 16th century whale oil was obtained from fisheries in the Bay of Biscay. When catches were diminishing because of over-fishing, whaling moved further afield, and by the early part of the 17th century it had reached the rich fishing grounds of Spitzbergen. All the seafaring nations of the day shared in them, and in order to prevent collision of interests among them they divided the coast of Spitzbergen and the adjacent seas into districts, assigned to the British, Dutch, French, Danes, the Hanseatics of Hamburg, and so on. Nothing can give a more vivid idea of the extent and importance of the Dutch whale fishery in the middle of the 17th century than the fact that the Dutch erected a considerable village, the houses of which had been prefabricated in Holland, on the Isle of Amsterdam on the northern shore of Spitzbergen. The quantity of oil made there was so great that it could not be shipped by the whalers alone; every year vessels were sent out in ballast to assist in importing the produce of the fishery. The inevitable result was that whales became less common and retreated to the eastern coast of Greenland.

Despite the number of whales slaughtered and the amount of oil produced, whaling does not seem to have been profitable for the British whalers of the early 18th century. In 1725, the English South Sea Company engaged in it in a large way and prosecuted it for 8 years. At the end of that period, having lost a large amount of money, they would have given up, if Parliament had not resolved in 1732 to support the trade by annually granting a subsidy of 20 shillings a ton to every ship of more than 200 tons engaged in it. When this figure proved to be insufficient, it was doubled in 1749. At once, whaling became profitable and the number of British whaling ships increased to over 100 during the next 25 to 30 years. Deceived by the prosperous appearance of the trade, Parliament imagined it to be firmly established and reduced the bounty to 30 shillings in 1777. In the course of the next 5 years the number of vessels dwindled from 105 to 39. To arrest this decline the subsidy was raised to its former level in 1781, and the trade revived. However, in 1787, the subsidy was again reduced to 30 shillings, in 1795 to 20 shillings, and by 1824 it was no longer paid. The northern whale fishery thereupon declined till 1842 and then remained more or less stationary. It has been estimated that between 1750 and 1824 approximately £2½ million was paid out in whaling subsidies. The average price of whale oil was around £30 a ton.

The whaling ships were almost exclusively based on the eastern seaboard of Britain. From 1780 to 1790, London with over 70 vessels sent out four times as many ships as any other port, but by 1836 not a single whaler was left in London. Hull became an early rival and by 1820 was the most important centre of whaling in the British Isles with over 60 vessels; by 1850, only 12 were left. In Scotland, Berwick, Leith, Kirkcaldy, Dundee, Montrose, Aberdeen, Peterhead, Kirkwall, Greenock, Banff, and Bo'ness took part in whale fishing. Peterhead, having sent out her first whaler in 1788, was the principal whaling port in 1857 with 34 vessels, but by 1893 she had abandoned the trade, leaving what remained of it to her rival Dundee, which in her turn left it to Leith.

By the middle of the 19th century, the main hunting grounds of the whale had had to be moved to the southern hemisphere. They had been opened up as early as the 1770's by the British, but, as everyone knows who has read "Moby Dick", the Southern Seas were the domain of the American whalemen from Nantucket in Massachusetts. They pursued the trade on a grand scale and made it pay; they needed no subsidy. In 1775, they had 121 vessels there; in 1846 the figure was 736; in 1856 it was 635; but in 1866 it dropped to 263. The latter figure no doubt indicates that new fuels were replacing whale oil, but in addition it surely indicates that the Americans were experiencing what the British, French, and Dutch had found earlier on: the stock of whales had been depleted because of an ever increasing demand for whale oil by a world which was becoming industrialized and whose population was growing and moving from the land into the towns.

**The Coming of Petroleum Products**

The population of Great Britain increased from 11 million in 1801 at the rate of 2 million every 10 years to 23½ million in 1861. At the turn of the 18th century 80 per cent of Britain's population was living in the country although only one third was engaged in agriculture; by 1851, already half the population was living in towns. They were keeping later hours than their rural forefathers and heeded the saying of "early to bed and early to rise" less strictly. Yet there was no need to fear that the world might be plunged into darkness at night from lack of fuel. Gaslight had been invented around the 1800's, lamps and candles had been improved, and by the 1860's petroleum products had become a commodity of trade between the New and the Old World.

As early as 1781 the idea had been mooted to use some of the oils obtained from the distillation of coal for lighting; but it was not until 1820, when coal gas was establishing itself in the larger towns, that the idea was put into practice by the invention of the Holliday lamp. The fuel oil was stored in a conical reservoir, from the apex of which it flowed through a capillary to a rose burner, which, heated by the flame, vaporized the oil and fed a ring of small jets of flame. This invention obviously came before its time.

The distillation products of coal, wood, bituminous materials, and oil shale aroused the interest of chemists everywhere in those days. Among these products was paraffin wax, a substance already known from other sources. It had been described as *Bergwachs, i.e.* mountain wax; it had been found in crude oils; it was scientifically investigated by Reichenbach in 1830, who gave it its name to describe its inert nature, *parum affinis, i.e.* of low affinity. It was obtained from bituminous shale by Laurent in 1830. In 1838 and 1839 Selligue obtained two French patents to protect his process for the production of paraffin wax from bituminous schists, and in 1845 Du Buisson took out British Patent 10,726 for the production of lamp oil, lubricating oil, grease, and paraffin wax suitable for candle making by the steam distillation of bituminous schistus and other bituminous substances.

**"Paraffin" Young**

Two years later, in 1847, a small stream of crude oil was discovered in the strata above a coal-mine at Alfreton in Derbyshire by James Oakes, brother-in-law of Lyon Playfair. James Young, later to be known as "Paraffin" Young, who at that time was manager of the chemical works of Charles Tennant & Co. in Liverpool, was asked to advise on its exploitation by his friend Playfair. As Tennant's were not interested in the scheme, Young resigned from his position and devoted himself to the new task of obtaining lamp oil and lubricating oils from the Alfreton crude by distillation.

*"Paraffin" Young*

The best lamp for these oils seems to have been invented in 1853 by Strohwasser of Berlin, to which place Young exported a fair amount of his output. It was not long before a similar lamp appeared on the British market manufactured by one Laidlaw of Edinburgh.

In due course, this Alfreton crude yielded another product. Playfair relates that "this oil, when cold, deposited shining crystals which I recognized to be the paraffin of Reichenbach. I suggested to Young that it might be made into candles, and with much difficulty he got enough to make two candles which I exhibited in a lecture at the Royal Institution, placing them lighted at each side of my desk. Young kept the remains of these original candles as a memorial of the origin of one of the largest of the chemical industries of modern times. At the Glasgow exhibition of 1888, Young's Paraffin Oil Co. had a large display in which they showed a bust of myself by Brodie in paraffin".

Young was not content merely to exploit the oil find at Alfreton; he had the enquiring mind that wants to know how oil came to be in that strata above a coal deposit. He argued —logically enough—that heat from the interior of the earth had caused the slow distillation of coal and that the crude oil he was exploiting at Alfreton was the distillation product. If nature could make oil from coal, man probably could do the same in a specially designed distillation plant. The result of this line of argument and of much experimenting and designing was his British Patent No 13,292 of the year 1850 for "treating bituminous coals to obtain paraffine and oil containing paraffine therefrom". It bears the subtitle: "Improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom".

While Young was engaged on this project, a friend, Hugh Bartholomew, with whom, like Lyon Playfair, he had studied chemistry at the Andersonian College in Glasgow and who was now manager of the Glasgow gasworks, sent him a sample of cannel coal from a deposit in Bathgate halfway between Glasgow and Edinburgh. It was unsuitable for gas making, but when lit it burnt with a bright light like a candle although it spluttered somewhat. It was found to contain 60–70 per cent of volatile matter and yielded almost twice as much oil as other kinds of coal when treated according to the process specified in Young's patent.

A company was formed by Young in association with Edward Meldrum, a chemist, and E. W. Binney, a lawyer, for the exploitation of the deposit. When it was seen to be near exhaustion in 1862, Young changed to oil shale as a raw material which he had been investigating as early as 1856. By 1859 he was producing oil from shale as well as from cannel coal, in order to extract paraffin wax besides lamp oil, lubricating oil, and other by-products. One ton of shale yielded approximately 30 gal of oil, of which 13 per cent was paraffin wax.

In 1864, Meldrum and Binney decided they had made enough money and sold their shares in the business to Young for £50,000. When, in 1866, Young sold the business to Young's Paraffin Light and Mineral Oil Co. for about £400,000, the production was running at over $6\frac{1}{4}$ million gal of oil a year.

Young's success gave rise to a large amount of litigation from individuals and from business firms. In each case an attempt was made to show that Young had been forestalled by others in the production of paraffin from coal or other bituminous matter. Each time Young was successful, for what he claimed as his invention was "the best means with which I am acquainted for . . . the obtaining of paraffine oil, or an oil containing paraffine, and paraffine, from bituminous coals by treating them in manner hereinbefore described".

The process was carried out under licence from Young in the United States for several years, and cannel coal was exported from Scotland to the New World until crude oil was struck in quantity in 1859 near Titusville, Pennsylvania. This strike opened up an abundant and cheap source of raw material for the production of lamp oil, lubricating oil, and paraffin wax and put an end to the American shale oil industry. The Scottish shale oil industry continued to expand up to the beginning of the First World War and is still in operation.

The discovery of oil did not diminish the value of Young's patent in the United States; it rather enhanced it as the crude had to be subjected to slow distillation for the production of

oils, greases, and waxes. This was not immediately conceded by American manufacturers, but in 1864 the U.S. Commissioner of Patents ruled that "the manufactures of coal oil in U.S.A. had their origin in Dr Young's patents. The use of petroleum followed so directly and obviously from the use of coal oils that the one originated from the other. Previous to Dr Young's discovery, petroleum had little or no commercial value".

These words can be applied with equal force to oil shale, cannel coal, paraffin wax, and coal distillates. Young turned these substances from objects of study in the chemistry laboratory into industrial raw materials and commercial products. His inventive mind kept the lights burning, and made them burn brighter, when the supply of older fuels was insufficient to keep pace with the demands of an expanding industrial society.

"Paraffin" Young's place in the history of human progress is secure.

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# Petroleum in Parliament

### Oil Duty Revenues

The following details of hydrocarbon oils retained for home consumption during the year ended 31 March 1961 and the net amount received in respect of duty thereon were given by the Economic Secretary to the Treasury in reply to a question on 10 July.

| *Class* | *Quantity* | *Receipts of duty* |
|---|---|---|
| *Oils chargeable with Customs Duty* | *gallons* | £ |
| Light Oils: ... ... ... | 2,564,277,649 | 320,596,623* |
| of which motor (including aviation) spirit ... ... | (2,505,421,042) | (313,177,625) |
| Heavy Oils: | | |
| For use as road fuel ... | 685,420,639 | 85,677,580 |
| Other (mainly lubricating oils) ... ... ... ... | 204,937,862 | 853,928 |
| *Oils chargeable with Excise Duty* | | |
| Light Oils: ... ... ... | 99,129,434 | 6,195,590 |
| of which motor (including aviation) spirit ... ... | (33,611,769) | (2,100,736) |
| Heavy Oils for use as road fuel | 24,404,888 | 1,525,305 |
| TOTAL ... | — | 414,849,026 |
| Allowance on certain home-produced oils used in approved refineries as raw material for chemical synthesis ... ... | — | 6,077,224 |
| NET TOTAL ... | — | 408,771,802 |

These particulars relate to oils subject to a net liability to Customs or Excise duty: comparable figures are not available in respect of heavy oils for which the duty was wholly rebated.

*Includes £61,414 in respect of light oils contained in composite goods on which oil duty was charged at a flat rate under the Composite Goods Order, 1958, and for which information as to the quantity of oil is not available.

### Enquiry into the Oil Industry Refused

A request for an authoritative committee to be set up to enquire into the economics of the oil industry, contained in a written question to the Chancellor of the Exchequer, was turned down on 3 August by the Economic Secretary to the Treasury.

### Oil Imports from Kuwait

About 24 million tons of crude oil and products were imported direct from Kuwait in the 12 months ended 31 May 1961. The value of these imports was £167 million and they represented 39 per cent by volume of total oil imports. This information was given by the Minister of Power in a written answer on 3 July. He added that some additional quantities of Kuwait oil which could not be identified reached the U.K. after refining in other countries.

### Oil in the Power Industries

During a short debate on coal and steel on 1 August, Albert Roberts (Normanton) claimed that in 10 years control of all oil supplies would have passed out of the hands of Europeans. Coal, of which there were sufficient reserves to last for 400 years, would then be the only form of fuel on which the country could rely.

Mr Roberts said that the gas industry was using too much oil, and greater use should be made of the Lurgi system for producing high-pressure gas from inferior fuels. He also made a plea for the adoption of a national fuel plan, and deprecated the use of oil by the electricity industry.

He said that if there was to be industrial expansion at the rate of 3 per cent per year, then the use of coal could be expanded without a reduction in the amount of imported oil.

In his reply, the Parliamentary Secretary to the Ministry of Power said that in addition to two Lurgi plants already projected there might possibly be more. The National Coal Board and the Gas Council were examining the system to see if it had economic advantages over the use of liquid methane, and whether it was the cheapest method of producing gas. If it was, then its future was assured.

He said that oil had an important part to play in the gas industry in meeting peak loads. The capital charge for oil plants to meet peak loads was less than the cost of a corresponding carbonization plant. If, as was expected, the gas industry expanded its output by about 25 per cent in the next 10 years there was room for coal at its present level of consumption, and for oil and other products required to make cheap fuel.

# New Chemical for Oil Firefighting

## *Extinction by Oxygen Removal*

The business of protecting oil installations of varying types, from drilling rigs to oil refineries and storage facilities, occupies a great deal of time and effort throughout the petroleum industry, and a considerable amount of expense in preventive measures and astronomical insurance premiums. When even the most stringent precautionary measures occasionally fail the dangers arising from oil fires are obvious and the expense in putting out the fire often assumes fantastic proportions.

The petroleum industry is constantly aware of the need to perfect the chemical agents used for the fighting of such fires, and a new chemical which has been evolved for this purpose, and the use of which was recently demonstrated, is of interest to all those connected with fire and safety in the industry.

The editor attended the demonstration, held on the flat coastal foreshore on the German North coast in the region of Emden. In dry sunny weather, with a south-west wind of variable force 5–10 mph coming from the sea, the potential of the as yet un-named chemical was seen in a variety of small-scale applications.

The agent itself has a thick grey-black oily appearance and the pungent smell given off suggests the presence of sulphur dioxide. When coming into contact with paper or wood, gasification occurs. It vaporizes at normal temperatures when exposed to the atmosphere and bubbles off in small quantities. Its operating principle is the extinguishing of flames by acting upon, and removing, the oxygen from the area above the fire.

Demonstrations carried out on automotive diesel oil in oil drums and 100 litre steel tanks produced effects of a similar nature but of obviously varying quantities. The chemical was applied in most cases by means of a portable pressure extinguisher applied from a distance of 15–20 feet away, after a preliminary burning period.

On application there was at first a sudden flame increase due to the pressure application, with a dense reddish-black cloud, which soon turned to black and then a pure white as it dispersed from the immediate area. In each demonstration the fire was extinguished either immediately or within a few seconds of the chemical's initial application.

In further demonstrations a glass bottle containing 10 litres of the agent was suspended over oil on fire in the tank and broken from a distance to simulate fracture by heat. The resulting explosion was followed once again by the changing smoke cloud mentioned previously and the fire was extinguished immediately.

Demonstrations of the chemical's effect on oil spillage fires was shown when a small area of the short tough grassland was covered with oil and ignited. The extinguishing jet covered a good fire area rapidly and once again the same results were seen, with the fire being immediately extinguished. The grass was left in a heavily blackened condition—a tar-like appearance not solely occasioned by the burning itself.

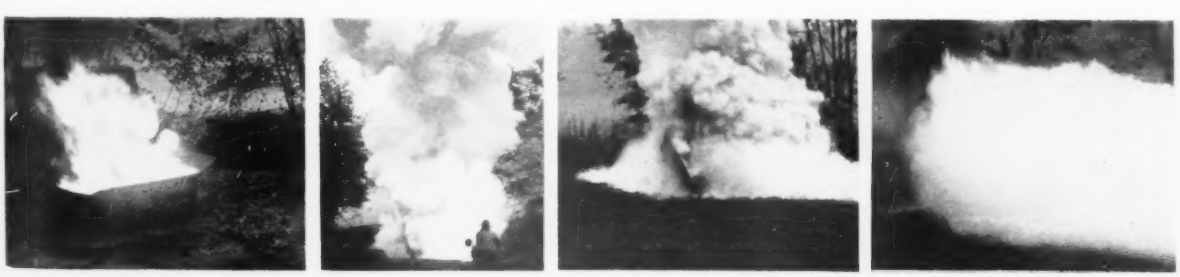
The chemical agent showed a decidedly acid effect when applied to clothing, human flesh, or water. The *immediate* application of water will counter this action although a stain is often still noticeable on materials.

The company manufacturing the chemical, Pobisco, is a Swiss concern which is registered in Lichtenstein. The intended commercial application of the agent is wide, and includes the fighting of oilwell fires—where it is claimed the crude oil would remain unaffected—oil tankage and refinery fires. It is also intended for use against phosphorus fires, an application in which there is no effective extinguishing agent to-day.

The chemical's potential as a fire-preventive agent is also to be explored. One important application that has been envisaged is for countering fires aboard oil tankers at sea or in harbour, by the suspension of liquid containers above the oil cargo, which, when subjected to higher than normal tank temperatures, would overturn and spill their chemical contents over the burning oil.

Further information on the Pobisco chemical can be obtained from the Company's agent in London, B. M. Chorzelski, at 56 Bassett Road, London, W.10.

*The photographs show the chemical at work at a small-scale demonstration in Switzerland. First the burning tank, the chemical is applied, and the black-red cloud is superseded by the white smoke*



# The World Oil Industry 1960

Like its predecessors, the latest edition of BP's *Statistical Review of the Oil Industry*, covering the year 1960, is a compact compendium of facts relating to the oil industry, and a useful work for quick reference.

**Reserves**

The tables dealing with reserves indicate that world proved oil reserves rose by a modest 2·6 per cent in 1960, the total of 41,010 million tons being 1055 million tons higher than at the end of 1959. The largest increase was achieved by the Soviet Bloc, where reserves rose by 455 million tons, or 11·2 per cent, to 4500 million tons. The 220 million-ton increase in the Middle East was substantially less than the rise of 970 million tons achieved in 1959. The only major increase in the Middle East was recorded by Iraq, where reserves rose by 260 million tons to 3570 million tons. In North America, a small drop of 15 million tons in U.S. crude oil reserves was more than offset by an increase of 35 million tons in reserves of natural gas liquids, and Canadian crude oil reserves rose by 30 million tons to 550 million tons. After doubling in the previous year, Argentina's reserves rose by a further 30 million tons to 310 million tons. Also among the more notable increases were those of Africa, which rose by 110 million tons, and those in the region classified as "Other Far East", which includes Japan, which rose by 100 million tons.

TABLE I

WORLD "PUBLISHED PROVED" OIL RESERVES AS AT END OF 1960 AND 1959

(million tons)

| *Western Hemisphere* | 1960 | 1959 | *Eastern Hemisphere* | 1960 | 1959 |
|---|---|---|---|---|---|
| U.S.A. | | | Middle East | | |
| Crude oil ... | 4,190 | 4,205 | Iran ... | 4,660 | 4,660 |
| Natural gas liquids ... | 790 | 755 | Iraq ... | 3,570 | 3,310 |
| Canada ... | 550 | 520 | Kuwait ... | 8,415 | 8,415 |
| Mexico ... | 310 | 345 | Neutral Zone | 865 | 935 |
| Argentina ... | 310 | 280 | Qatar ... | 320 | 320 |
| Colombia ... | 105 | 105 | Saudi Arabia | 6,660 | 6,660 |
| Peru ... ... | 50 | 45 | Other Middle East ... | 80 | 50 |
| Trinidad ... | 65 | 60 | | | |
| Venezuela ... | 2,650 | 2,580 | Total ... | 24,570 | 24,350 |
| Others ... | 70 | 55 | | | |
| | | | Africa ... ... | 1,155 | 1,045 |
| | | | Western Europe | 240 | 210 |
| | | | East Indies ... | 1,270 | 1,270 |
| | | | Other Far East | 185 | 85 |
| | | | U.S.S.R. Bloc | 4,500 | 4,045 |
| Total Western Hemisphere | 9,090 | 8,950 | Total Eastern Hemisphere | 31,920 | 31,005 |

**Production**

World production, which was slightly ahead of the increase in reserves, was some 7 per cent higher at 1078·9 million tons. The most significant increase took place in the Middle East, where output was 32·9 million tons higher, a rise of some 14 per cent compared with the annual average of 10 per cent for the period 1955–60. The more spectacular percentage increases however, were achieved by the smaller producing countries such as Algeria (including Sahara), where production of 8·3 million tons was 536 per cent higher, and Argentina where there was a 43 per cent increase to 9 million tons. U.S. production rose by less than 1 per cent to 381·6 million tons, and the other North American producers, Canada and Mexico, both had increases of less than 1 million tons.

**Consumption**

The world demand for oil rose by 8 per cent, which was slightly in advance of the trend in the last 5 years. The rise in consumption of 19 million tons in the Western Hemisphere to 595 million tons represented an increase for the year of 3 per cent, which was slightly below the recent annual average.

TABLE II

WORLD OIL CONSUMPTION 1960 AND 1959

| | 1960 *million tons* | 1959 *million tons* | *Change* 1960 *over* 1959 % | *Change* *Average* 1955 *to* 1960 % | 1960 *share of total* % |
|---|---|---|---|---|---|
| U.S.A. ... ... | 469 | 457 | + 3 | + 3 | 44 |
| Canada ... ... | 42 | 40 | + 5 | + 6½ | 4 |
| Mexico ... ... | 14 | 13 | + 9 | + 9 | 1 |
| Caribbean ... ... | 28 | 28 | — | + 6 | 3 |
| Other Western Hemisphere ... ... | 42 | 38 | +11 | + 8 | 4 |
| Total Western Hemisphere ... ... | 595 | 576 | + 3 | + 3½ | 56 |
| Western Europe ... | 202 | 172 | +17 | +12 | 19 |
| Africa ... ... | 22 | 21 | + 7 | + 6 | 2 |
| Middle East ... | 26 | 22 | +16 | +12½ | 3 |
| East Indies ... ... | 5 | 5 | + 4 | + 3½ | 1 |
| Australasia ... ... | 13 | 12 | + 8 | + 8 | 1 |
| Other Eastern Hemisphere ... ... | 55 | 46 | +20 | +18 | 5 |
| Total Eastern Hemisphere ... ... | 323 | 278 | +16 | +11½ | 31 |
| World excl. U.S.S.R., etc. ... ... | 918 | 854 | + 7 | + 6 | 87 |
| U.S.S.R., etc. ... | 142 | 129 | +10 | +15 | 13 |
| World ... ... | 1,060 | 983 | + 8 | + 7 | 100 |

In the Eastern Hemisphere, however, the rise of 16 per cent to 323 million tons surpassed the annual average of 11½ per cent for the period 1955–60. Table II shows that in the Eastern Hemisphere, Western Europe, the Middle East, and the area designated "Other Eastern Hemisphere", with respective increases of 17, 16, and 20 per cent and consumptions of 202, 26, and 55 million tons, all exceeded the overall world increase of 8 per cent. In addition, Africa and the East Indies experienced increases in excess of their own

average annual rises in recent years. Fuel oils were again responsible for the major part of the increased consumption in Western Europe, and in North America, where there was an increase of 2·9 per cent in the overall consumption to 525 million tons, the growth in jet transport produced a 17 per cent increase in kerosine sales, which reached 20 million tons, compared with a recent average rise of 3 per cent.

**Supply and Demand**

Although the proportion of world oil production entering international trade fell to 40 per cent in 1959, this trend was reversed slightly in 1960 when the proportion reached almost 42 per cent. This was the result of increased consumption in Western Europe and the Far East, which more than balanced a growing self-sufficiency in some other parts of the world.

**Refining**

Refining capacity rose by 5 per cent, or some 58 million tons, to 1119 million tons compared with an average annual increase of 8 per cent in the five years 1955–60. This increase was again below that in the growth of world demand for oil. The most impressive increase in refining capacity occurred in Trinidad, where there was an increase of 56·5 per cent to 13 million tons, and Germany, where capacity rose by 39 per cent to 37 million tons. On a regional basis, the largest increase in volume occurred in Europe, where capacity rose by 13 per cent to 200 million tons.

**Tankers**

The world tanker fleet rose by 3·1 million dw tons to 64 million tons. Oil companies owned 23·2 million tons of this total. Some 17·5 per cent of the total tonnage was registered in Liberia, while Britain's share was 15 per cent, and Norway's 14·5 per cent. New tanker deliveries during the year fell to 5·5 million dw tons, which was about $1\frac{3}{4}$ million tons below the previous year's record level. Laid up tonnage fell by some 2 million tons and tankers under construction declined by 5 million tons to $14\frac{1}{2}$ million dw tons.

**Historical**

Dealing with world trends since 1938, the book records a growth in production from 274 million tons to 534 million tons in 1950 and a further doubling in output to 1960 when almost 1079 million tons of oil were produced. Reserves are shown to have grown from 4585 million tons in 1938 to 12,130 million tons in 1950 and 41,010 million tons at the end of 1960. The statistics also record a growth of over 316 per cent in consumption, which stood at 255 million tons in 1930 and is now 1060 million tons.

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# Lectures, Courses, and Conferences

**General Technology of Petroleum**

The first of the 1961–62 series of lectures on the "General Technology of Petroleum" will be given at Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, on 28 September. The fee for the course is £5.

**BCAC's First Annual Lecture**

Dr D. G. Christopherson, O.B.E., F.R.S., Pro-Vice-Chancellor of the University of Durham and Warden of the Durham Colleges, is to give the first annual lecture of the British Conference on Automation and Computation. His subject will be "Mathematics—Friend or Foe?"

The lecture, which is to be given at the Lecture Theatre of The Institution of Electrical Engineers, Savoy Place, London, W.C.2, on Wednesday, 27 September, at 5.30 p.m., is open to all members of the 31 member societies of B.C.A.C. Others can obtain tickets free of charge from the Honorary Secretary, B.C.A.C., c/o The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

**Factory Equipment Exhibition**

The International Factory Equipment Exhibition is to be held at Earls Court, from 13–18 November 1961. It is 2 years since the last show was held in London and a great variety of new equipment is expected to be on show.

Several conferences will be run in conjunction with the Exhibition, which is being sponsored by the London Chamber of Commerce, *The Financial Times*, and *Industrial Equipment News*.

Details are available from Industrial and Trade Fairs Ltd, Commonwealth House, 1–19 New Oxford Street, London, W.C.1.

**Scientific Film Festival**

The 2nd International Festival of Technical and Scientific Films is to be held in Budapest from 16–25 November 1961. Films entered for the Festival will also be shown in a further eight industrial centres to a technically trained public.

The Popular Science Film Section of the International Scientific Film Association will be holding a session on "The Role of Popular Scientific Films in Technical Development" in Budapest at the same time. Details are available from the Office of the Organizing Committee of the Film Festival, Szabadsag ter 17, Budapest, Hungary.

**Health Conference for Executives**

The Third Health Conference for Executives is to be held on 30 November at the Connaught Rooms, London, W.C.2.

All the speakers will be eminent in the medical profession. The subjects will deal with personal, industrial, and community health problems. The fee of 4 guineas includes a printed report of the proceedings.

Details can be obtained from the organizing secretary of the conference, The Chest and Heart Association, Tavistock House North, Tavistock Square, London, W.C.1.

**Regional Plan for Courses in Technology**

Following consultation with the industry, the Ministry of Education, and local education authorities in London and the Home Counties, the Regional Advisory Council for Technological Education has drawn up a plan governing the development and distribution of Dip.Tech. courses in the region.

The plan, which is described in a new booklet published by the Council, is designed to avoid the over-provision of such courses, so that the numbers do not outstrip the number of students. By this means, it is hoped to maintain the high standards of the courses, the teaching, and research facilities.

The Council's address, from which copies of the booklet are available, is Tavistock House South, Tavistock Square, London, W.C.1.

# Books and Films

### Packaging in Europe

The *Packaging Directory, 1961* is claimed to be the most comprehensive guide to packaging in Europe ever published. It is much larger than previous editions and has over 370 pages.

The contents are divided into seven main divisions containing several thousand references to all aspects of packaging, including suppliers, manufacturers, and machinery. The directory is published by Tudor Press Ltd and costs 21*s* 0*d*.

### "Hold Back The Sea"

The Dutch people have waged their struggle against the sea since time immemorial. The heroic story of their tenacity in turning what was once an inhospitable region of extensive marshes and vast lakes into the fertile land of to-day is vividly told in a new Shell film, *Hold Back the Sea*.

It has been directed by a young Dutchman, George Sluizer, whose disciplined imagination has enabled him to create a film which captures all the drama of his fellow countrymen's struggle through the centuries and leaves one with a sense of admiration at their fortitude.

The first efforts to combat the ruthless encroachment of the sea was made by constructing mounds or hillocks, known as "terps", on which were built houses and churches, as well as various farm buildings. Early in the Middle Ages, the people learned to connect adjoining mounds by dykes which enabled them to keep limited areas of pasture dry.

From this modest beginning, they evolved techniques which enabled them to drain many thousands of acres of land and re-shape their coastline to create vast areas of rich new farmland.

The latest project in their relentless efforts to protect their land is known as the Delta Plan. This involves sealing off the estuaries in the south and south-west of the Netherlands. It is an enormous task, but one which is well advanced.

*Hold Back the Sea* is in Eastmancolour and runs for 29 minutes. It is available on loan from The Petroleum Films Bureau, 29 New Bond Street, London, W.1, or The Scottish Films Offices, 16–17 Woodiside Terrace, Charing Cross, Glasgow, C.1.

* * *

## MIDDLE EAST OIL PRODUCTION

| | *June* | *Jan.–June* |
|---|---|---|
| | *Tons* | |
| Iraq Petroleum Co. Ltd ... | 3,007,437 | 17,933,746 |
| Basrah Petroleum Co. Ltd ... | 785,539 | 4,608,913 |
| Mosul Petroleum Co. Ltd ... | 103,576 | 641,033 |
| Qatar Petroleum Co. Ltd ... | 682,882 | 4,097,048 |
| Iraanse Aardolie Exploratie en Productie Mij ... ... | 4,872,000 | 27,842,000 |
| | *Barrels* | |
| Arabian American Oil Co. ... | 37,166,253 | 254,662,331 |
| Bahrain Petroleum Co. Ltd ... | 1,351,069 | 8,183,977 |
| Getty Oil Co. and American Independent Oil Co. (Kuwait–Saudi Arabia Neutral Zone)... | 4,776,545 | 22,946,568 |

The refinery throughput at Abadan of the Iraanse Aardolie Raffinage Mij for June was 1,333,000 tons, the total for 1 January to 30 June being 6,513,000 tons.

Crude processed at Aramco's Ras Tanura refinery during June was 7,586,671 brl, the total for 1 January to 30 June being 45,956,672 brl.

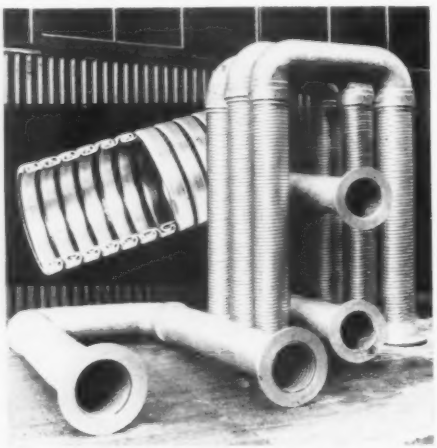
# Equipment Developments

### Flexible Tubing in Aluminium Alloy

Until recently, flexible metallic tubing was made only in galvanized steel, stainless steel, and bronze. The latest development in this field is the introduction of a new range of flexible tubing in aluminium alloy.

In the production stages, the aluminium is rolled and slit to fine tolerances and is then helically formed by means of its interlocking edges into tubing. A continuous sealing cord is introduced between the interlocking edges to maintain pressure tightness with flexibility.

The manufacturer, the United Flexible Metallic Tubing Co. Ltd, is using a high-strength aluminium-magnesium type alloy, Alcan Industries' *Noral 54S*, for the new tubing to give a tube suitable for pressure service at about one-third the weight of similar tubing in other metals. Working pressures range from 300 psi for ¾-in tubing to 75 psi for 12-in bore tubing.

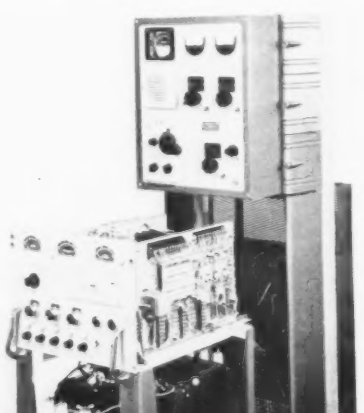


*These 8-in flexible tubing assemblies are used in Shell tankers for flushing pipelines and tankers with sea water. Inset is a partly sectioned length of tubing*

The makers expect the new tubing to be particularly useful in the handling of corrosive gases or liquids, and in the processing of liquefied gases or other materials at very low temperatures at which other metals suffer embrittlement.

### Rack-Mounted Linear Amplifier

A newly designed self-contained rack-mounted linear amplifier intended primarily for single sideband and independent sideband service is announced by the Canadian Marconi Co. Designated Model BH48, it provides 1 kW of peak envelope power in the range of 2 to 28 Mc with an input drive level of 0·1 W. The design employs a modern ceramic tetrode tube operating under class $AB_1$ conditions. This results in an extremely simple unit driver unit employing conventional type receiver tubes.



*For ease of maintenance, the power supply for the Canadian Marconi Co's new linear amplifier rolls out of the cabinet on castors.*

# Trade Literature, etc.

### Electric Valve Actuators

Robustness and an ability to withstand man-handling are advantages claimed for a new range of industrial electric valve actuators introduced by Rotax Ltd. They have been designed primarily for use with edge gate valves over the range from 6-in to 72-in stroke, having a thrust rating between 2000 lbs and 50,000 lbs. The thrust value is adjustable by means of a torque limiting device, and in the larger models either the motor operation or the manual operation can be arranged to take precedence over the other.

Specification sheets are available from Rotax Ltd, Process Controls, Willesden Junction, London, N.W.10.

### Stenungsund Steam Cracker

Detailed engineering and procurement of Svenska Esso's £7 million steam cracking plant, which is to be erected at Stenungsund, Sweden, is being carried out in London by Fluor Engineering and Construction Co. Ltd. The steam cracker is designed for the production and recovery of ethylene and butadiene and will form the core of the overall Stenungsund petrochemicals project. Construction work will start later this summer, and the plant is scheduled to go on stream in July, 1963.

### The Stretford Process for West Hartlepool

A *Stretford* liquid purification plant to eliminate hydrogen sulphide from 3 million cu ft of coke oven gas/day is to be erected by the Chemical Engineering Division of W. C. Holmes & Co. Ltd at the Northern Gas Board's West Hartlepool works. It is expected to come into operation in 1962.

The *Stretford* process was developed by the North Western Gas Board and The Clayton Analine Co. Ltd. In the new installation hydrogen cyanide will be removed from the gas before it enters the main *Stretford* plant to prevent sodium thiocyanate forming in the washing solution.

### Synthetic Ammonia Plant

A new synthetic ammonia plant is being added to the existing plant of Nitrogen Fertilizers Ltd at Flixborough, near Scunthorpe. The raw materials for the plant will be hydrocarbon gases drawn from nearby steelworks. The contractors, Chemical Construction (G.B.) Ltd, expect completion to be made towards the end of 1962.

### Fresh Water for Kuwait

With the installation of another *Multiflash* sea-water distillation plant at Mina-el-Ahmadi for the Kuwait Oil Co. Ltd, Kuwait will be using nearly 4 million gal/day of fresh water from plant of G. & J. Weir Ltd manufacture. Output of the new installation will be 600,000 IG day of fresh water.

### Distributor for Mobil Fuel Oils

Charrington, Gardner, Lockett & Co. Ltd and Hargreaves (Leeds) Ltd through a jointly owned company, Charrington-Hargreaves Ltd, have been appointed sole distributors of Mobil fuel oils for an area covering that part of England extending from the Scottish border southwards to the southern boundaries of Cheshire, Derbyshire and Nottinghamshire, and including some parts of Lincolnshire.

### Industrial Air Filter

The *Trion* electronic air filter, marketed by W. C. Holmes & Co. Ltd, has been redesigned and will in future be known as the *Industrion* electrical air filter.

The new filter is claimed to be sturdier than its predecessor. The collecting cell is fabricated from a heavier gauge aluminium and the supporting framework and ionizing section support bar have been strengthened. The insulators are now positioned out of the main air stream to facilitate cleaning. The associated electrical equipment has also been improved and there are now two standard sizes of power units. A further development is the introduction of a special heavy duty filter.

### Molybdenum Disulphide in Lubricants

A new 16-page publication from Rocol Ltd, entitled *No Warning Light for Wear*, describes the development of oil additives and the production of Rocol *Molyspeed* as well as the nature of molybdenum disulphide.

Copies of the booklet are available from the Company's Publicity Department at Rocol House, Swillington, near Leeds.

### Transistorized Vibration Meter

Dawe Instruments Ltd has published a new technical leaflet giving a comprehensive specification of its new fully transistorized vibration meter Type 1431, which operates from either battery or mains supply, and employs a moving-coil pick up.

The leaflet is available from the Company at its office at Harlequin Avenue, Great West Road, Brentford, Middlesex. The meter is calibrated in either British or metric units and has a frequency coverage of 5 c/s to 2000 c/s.

### Instrumentation for First Panama Refinery

Central America's first refinery, under construction near Colon, Panama, for Refineria Panama SA, will be equipped with miniature two-wire *ElectriK Tel-O-Set* units supplied by the American associates of Honeywell Controls Ltd.

In addition, Honeywell will supply control valves and valve actuators, thermocouples, and a console on which any of 168 process temperatures can be indicated.

### New Delivery Hose for the Oil Industry

*Drakeline*, a light and flexible delivery hose which has previously only been available for export is now being marketed in the United Kingdom. The hose has a synthetic woven jacket with external plastic coating and a seamless rubber lining. It is claimed to be resistant to most oil products providing the aromatic content does not exceed 25 per cent. It is made in sizes from 1½-in to 6-in internal diameter.

A descriptive leaflet is available from the makers, George Angus & Co. Ltd, Angus House, 152–158 Westgate Road, Newcastle-upon-Tyne, 1.

### Telemetering for Pipelines

Rotax Ltd is marketing a new telemetering system for oil and gas pipeline control, which has been developed in the United States by Dresser Electronics. Known as the SIEMARC system, it requires only one operator, the dispatcher, who, from a central office can supervise the running of the whole line. The remote pumping stations are under "set-point" control. This means that the dispatcher sets each station to work at a required level and the control equipment at the stations will then automatically decide on the number of pumps to be used, and their speeds.

A leaflet describing the system is available from Rotax Ltd, Willesden Junction, London, N.W.10.

### Joint Venture of Tidewater Oil and Air Products, Inc

Tidewater Oil Company and Air Products, Inc are to construct and operate an OXO alcohol plant adjacent to Tidewater's Delaware refinery to produce *iso*-octyl, decyl, and tridecyl alcohols, with eventual production exceeding 60 million pounds/year.

Tidewater Oil Company will provide the raw materials and will operate the plant, and Air Products will provide design engineering for the plant and will also be responsible for marketing its products

### Radar Equipment for ss "Canberra"

Kelvin & Hughes (Marine) Ltd has supplied the radar equipment for the 45,000-ton passenger liner ss *Canberra* which made its maiden voyage at the beginning of June.

The installation will provide two separate true-motion radar systems, with 16-in and 24-in master displays built into a navigational console in the wheelhouse. The 24-in display is photographically projected on to a paper surface so that direct plotting can be carried out. An independently controlled slave display is provided to work remotely off either of the two master displays. Twin 10-in scanners will be mounted on the foremast, and inter-system switching arrangements provide for any unit of either system to be used with units of the other system if required.

### New Issue of "Prospects"

The latest issue of *Prospects*, published by Acheson Colloids Ltd, contains a discussion of a new long-distance telecommunication system which describes the development of the tubular waveguide which permits hundreds of thousands of phone conversations to be handled simultaneously. There is also a feature on London Transport's use of molybdenum disulphide on escalators and compressors.

*Prospects* is available from Acheson Colloids Ltd, P.O. Box 12, Prince Rock, Plymouth, Devon.

### Protection for Buried Pipes

*Protexulate*, a fine mineral powder which provides buried heating pipes with thermal insulation and complete protection from corrosion, is claimed by the makers to be permanently waterproof, with thermal conductivity as low as k = 0·912, dependent upon the temperature. The dielectric constant is 2·7. It can be used for conduits with temperatures up to 480 F. It is applied simply by pouring it direct from the bags into the trench covering the pipe to a depth based on the dimensions of the pipes. The empty multi-ply paper bags are then placed over the powder and the trench is filled in with earth.

Croxton and Garry, who manufacture the product, has formed a subsidiary company Protexulate Ltd to market it.

### Oil-Ash Corrosion

Three of the abstracts in the January issue of *The Nickel Bulletin* deal with corrosion problems in oil-fired furnaces. Two of them describe papers published by the American Society of Mechanical Engineers on oil-ash corrosion of stainless steels and the use of additives to inhibit it, and methods of combating residual oil-ash corrosion. *The Nickel Bulletin* is obtainable from The Mond Nickel Co. Ltd, Thames House, Millbank, London, S.W.1.

### New Chromium-Nickel Alloy

The re-designed *Inco-Mond Magazine*, No. 17, contains an article on fuel-oil ash corrosion which describes a new 60/40 chromium-nickel alloy. Laboratory tests showed the new alloy to have a life between 12 and 25 times that of 25/20 chromium-nickel steel, depending on the constitution of the ash mixture. Copies of the magazine are available free of charge from the Publicity Department, The International Nickel Co. (Mond) Ltd, Thames House, Millbank, London, S.W.1.

### Corrosion Inhibitor for Residual Fuels

Sonneborn Chemical and Refining Corporation of New York has developed a new chemical additive, *Petrosene D*, which controls low and high temperature corrosion when burning residual fuels with high contents of sulphur, vanadium, and sodium. It is a non-abrasive liquid which can be added direct to fuel storage tanks. It has a high alkaline reserve (800/1000 mg KOH.g) for neutralizing $SO_3$. It deactivates vanadium and sodium complexes by raising their melting point to over 2000 F. Immunity life of new metals is increased by formation of a protective coating.

Technical literature describing the new additive is available from Petroleum Specialities Ltd, Norfolk House, Norfolk Street, London, W.C.2.

### Gallenkamp-Towers Publication

The latest issue of the twice yearly *News and Review*, published by A Gallenkamp & Co. Ltd, devotes more than 40 pages to brief descriptions of the Gallenkamp-Towers equipment which is to be displayed at the Achema Congress in Frankfurt from 9 to 17 June. It also contains papers on the newly-developed Lloyd gas analysis apparatus, the Company's ballistic bomb calorimeter, and the "Hydrogen Content of Steel-Bjerkerud Method". Copies are available from the Company at Technico House, Sun Street, London, E.C.2.

### New Attempt to Combat Diesel Fumes

*Redex D.D.* represents the latest attempt to combat the diesel fume problem. Basically, the new product is the normal formula *Redex* additive plus a newly-developed aromatic compound which acts as a deodorant.

Added in the ratio of one part to 150 parts of fuel, *Redex D.D.* is claimed to give diesel fuel a pleasant smell resembling vanilla and to reduce, or eliminate, the pungency of diesel exhaust gases. Its general effect is to mask the unpleasantness of diesel fumes rather than reduce their toxic effect, although laboratory tests have shown that the additive does produce a small reduction in the sulphur content of the gases.

The new product is intended primarily for use by those fleet owners of diesel vehicles who have their own storage depots.

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# Forthcoming Meetings

### THE INSTITUTE

*(At 61 New Cavendish Street, London, W.1, 5.30 p.m.—tea 5 p.m.)*

**Airborne Techniques in Petroleum Exploration.** W. Domzalski, A.R.S.M., B.Sc., D.I.C., Ph.D. **20 September**

**The Packaging of Lubricants.** H. G. Priest, A.C.W.A. **4 October**

### LONDON BRANCH

*(At 61 New Cavendish Street, London, W.1, 6.15 p.m.—tea 5.30 p.m.)*

**Molybdenum Disulphide.** G. J. Vineall, B.Sc., F.R.I.C. **26 September**

### SOUTH-EASTERN BRANCH

*(At the Sun Hotel, Chatham, 7.45 p.m.)*

**Building an Oil Refinery.** C. Billingsley **3 October**

### SOUTH WALES BRANCH

**Visit to Esso Refinery, Milford Haven** followed by combined meeting with South Wales Section of Royal Institute of Chemistry on **Ammonia and Nitric Acid Manufacture** **21 September**

### IP STANLOW BRANCH

*(At Grosvenor Hotel, Morecambe, 8.30 p.m.)*

**Plastics Related to Petroleum.** T. S. McRoberts, M.Sc., Ph.D. (Cantab), F.R.I.C. **29 September**

### YORKSHIRE BRANCH

**Visit to Melbourne Brewery (Leeds) Ltd** at 7.30 p.m. **14 September**

*(At Great Northern Hotel, Leeds, 7.30 p.m.)*

**Silicones.** R. Nattrass. **11 October**


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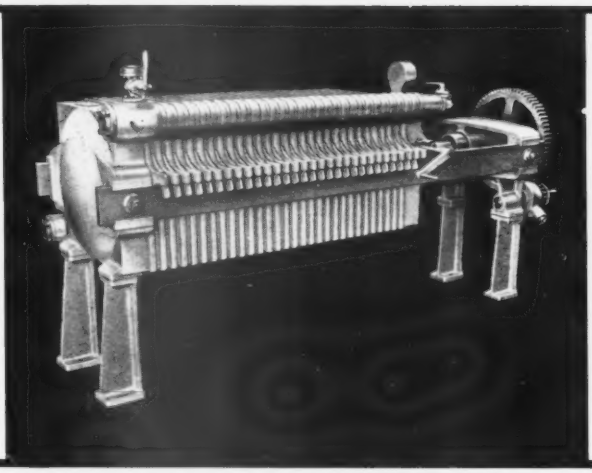

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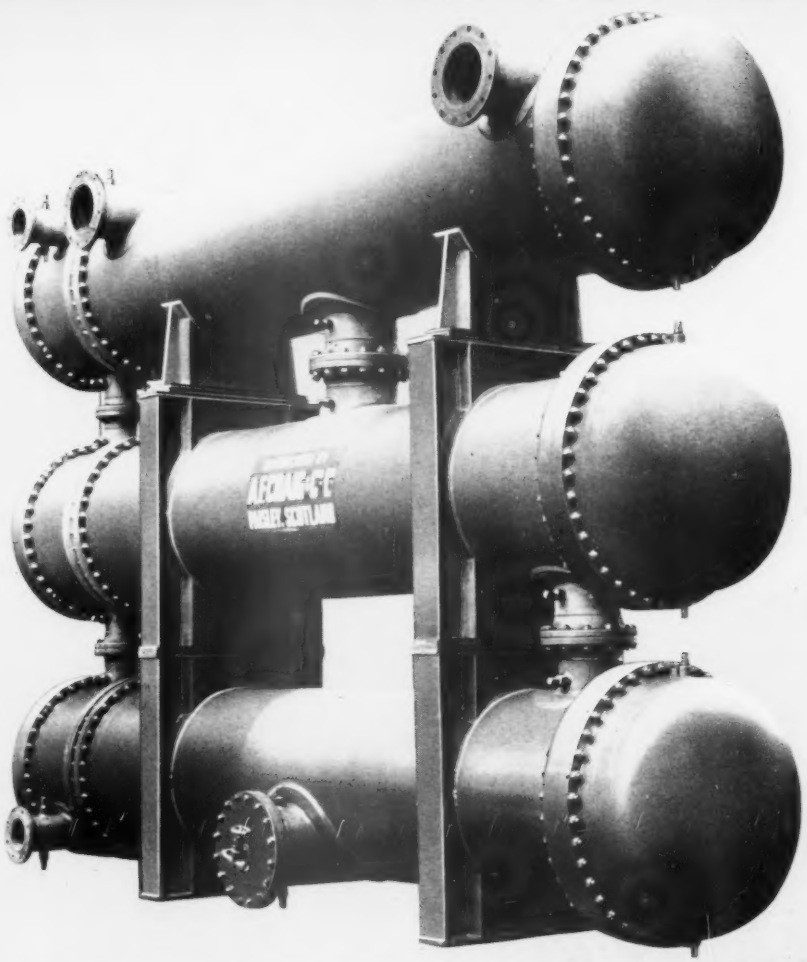

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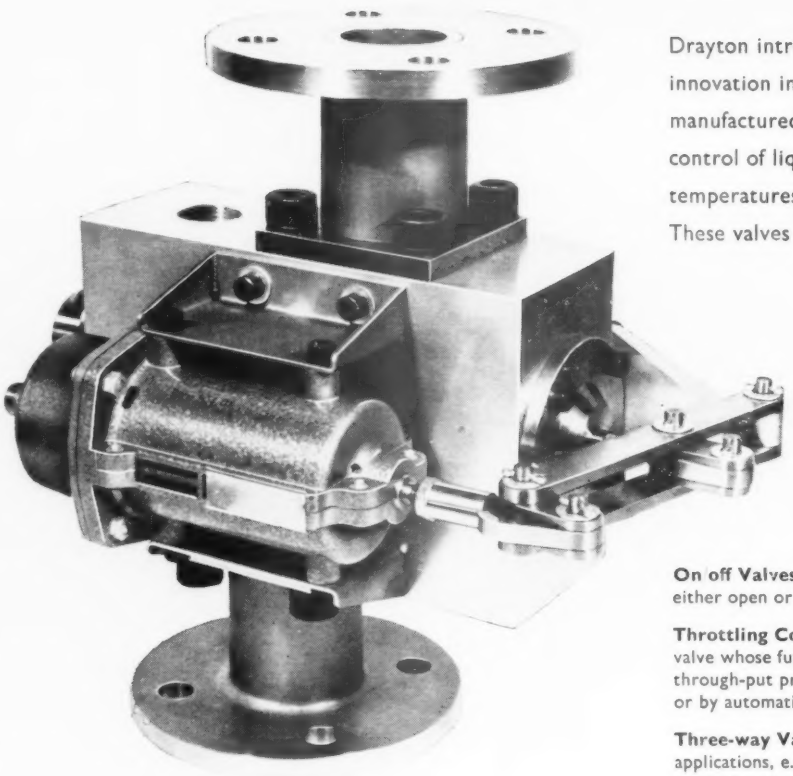

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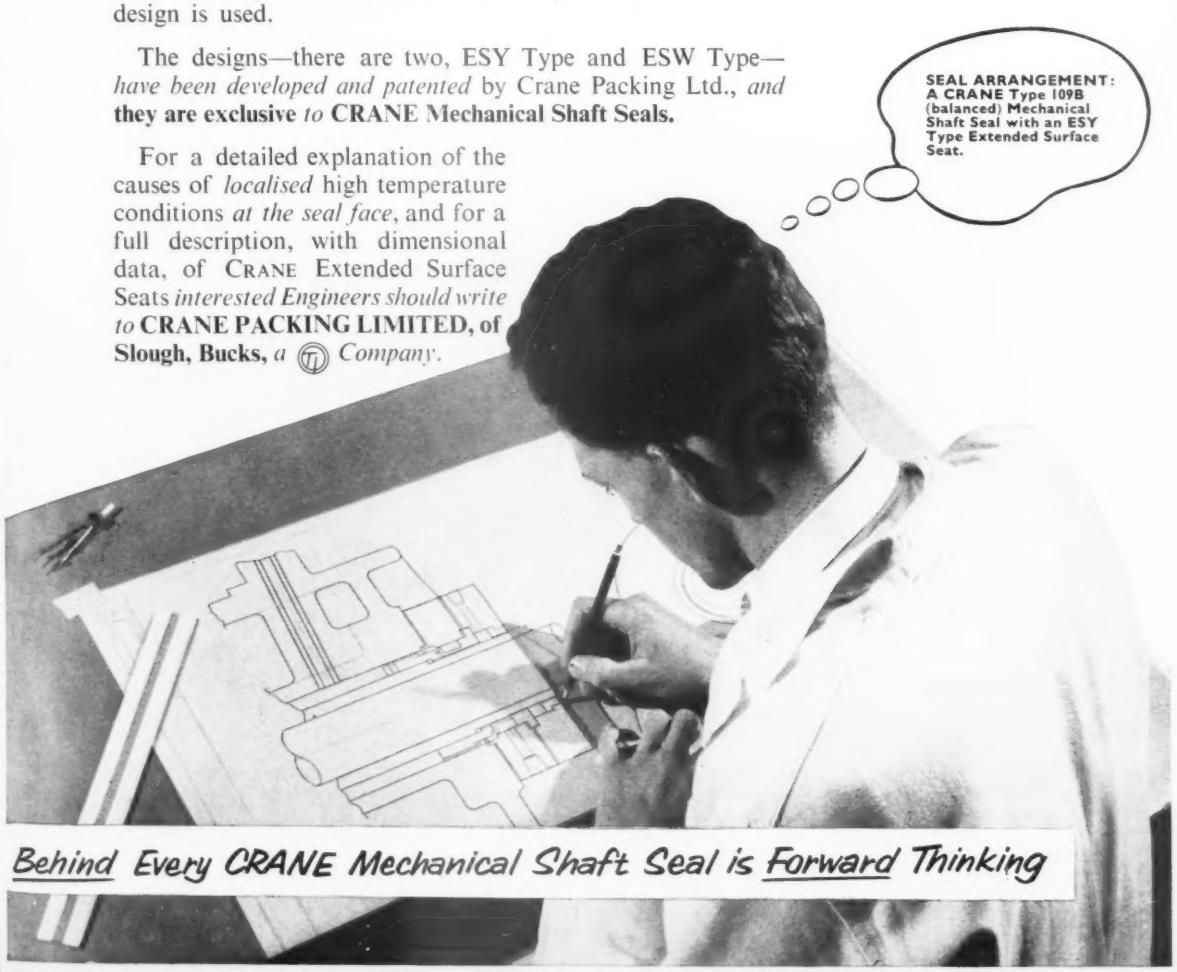


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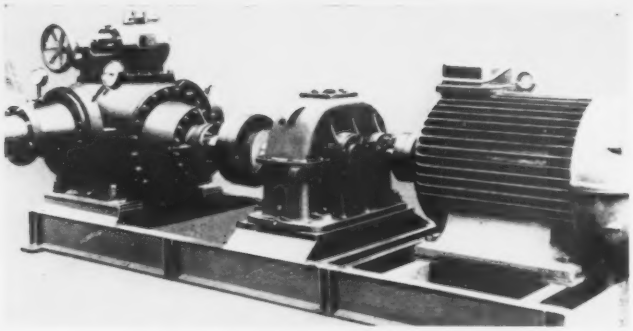

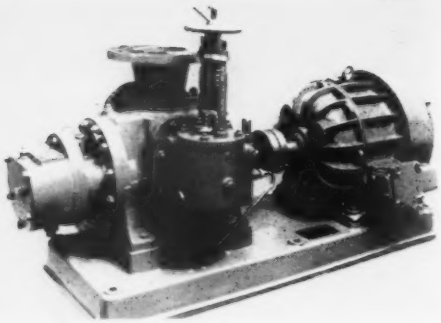

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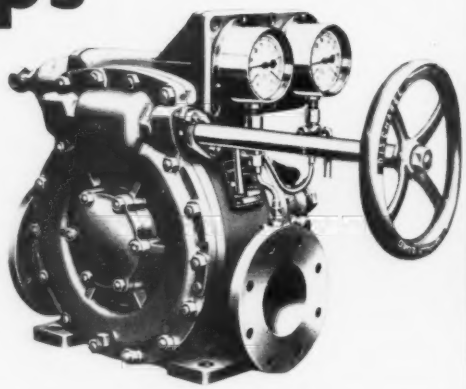

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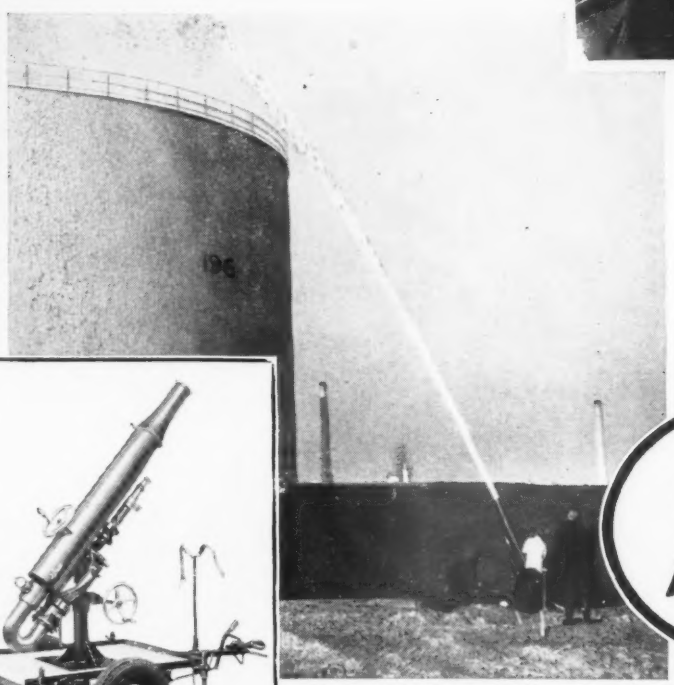

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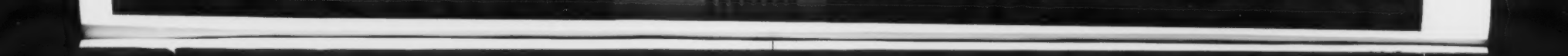

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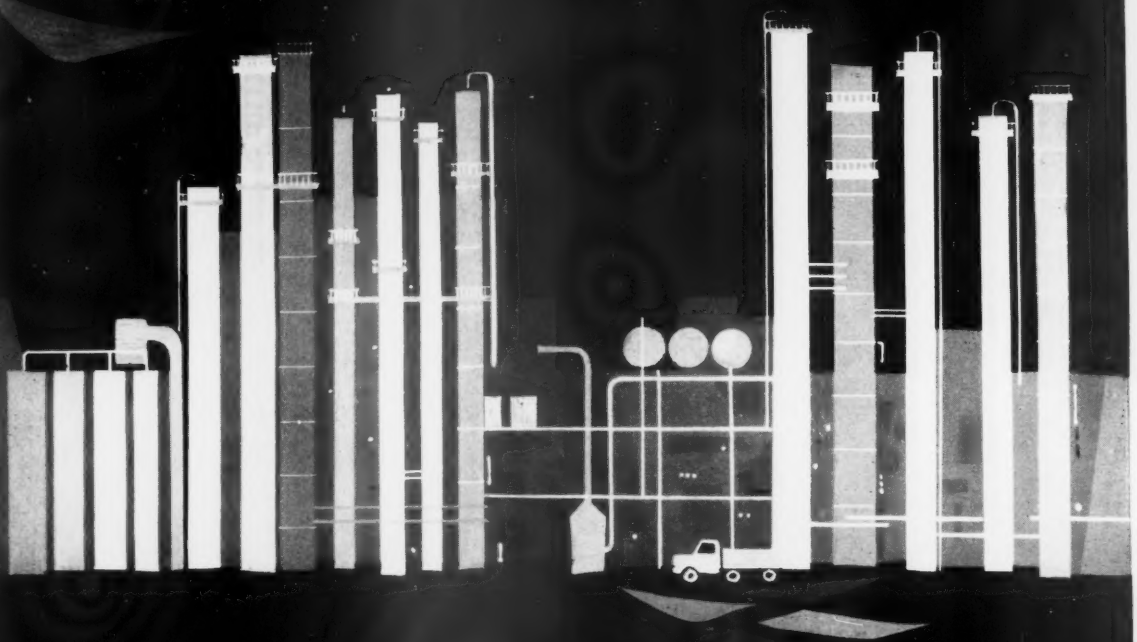

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